Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "THE ELECTRICAL ENGINEER."

VOL. XXXIV. NEW YORK, SATURDAY, NOVEMBER 18, 1899. No. 21.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico . . . . . per year, $3.00
Foreign Countries within the Postal Union, ... 6.00
Single Copies, ...10

In requesting your address changed give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

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THE TELEPHONE SITUATION.

While on the one hand the telegraph may be considered a stationary industry, from the fact that even in the best of times it shows no ability for expansion, the telephone would appear to have reached the stage at which it may be expected to make and show a more rapid development than at any period in the past. Whether the Bell telephone system would have grown rapidly had no opposition sprung up to force a fuller manifestation of its strength, is a question that can never be answered, but it is a fair inference that without a fight the development would have been slower. It is certain that with the expiration of the fundamental Bell patent, an era of expansion began on an enormous scale, and that it is still in its earlier stages. Never before has the Bell system been so thoroughly on its mettle as now, while never till now has the opposition assumed such proportions as to promise that the Bell figures may be equaled by those of the outside concerns. The new opposition seems bent on large work, but a good many manufacturing concerns have already sold thousands of instruments, representing in the aggregate a switchboard capacity of probably not far short of 300,000 subscribers. Just now the Bell productive capacity is strained to the utmost, and the independent manufacturers all report themselves as very busy. One of them showed us this week orders for some five exchanges in hand, for a total of over 20,000 subscribers. In addition to the new work, however, a large amount of work is impending, due to the enlargement or reconstruction of many exchanges now in operation.

Some data was given in our last issue as to the present work and income of the Bell system. It is, however, difficult to capitalize the value of such a plant as a going concern and still more difficult to get at the value of such a mass of unrelated parts as the independent system has been hitherto. The capital stock of the American Bell Company is $25,886,000, and there are outstanding $5,000,000 of debenture bonds. But the stock is selling around 350-360. There is also the American (long distance) system, whose stock has been raised to $75,000,000, and whose total present investment reaches perhaps $25,000,000. It is predicted that the whole Bell system may presently be rolled into one with a capital of $300,000,000, but that amount would hardly cover, for the face value of the stocks and bonds of the 47 subcompanies represent $150,000,000, and the quotations of many of these stocks is far above par, and the dividend rate has averaged around 6 per cent., in one case going up to 10, and in another to 12. It is a noteworthy fact that nearly all the properties are but lightly bonded, and the proportion of bonds is barely 10 per cent. of the capital obligations. Taken all in all, the Bell system enters the fight in excellent financial and physical condition, and if it needs more money, it appears to have abundance of credit.

ELECTRIC VEHICLES.

The fever for automobile development is still on, and bids fair to continue, although some of the figures that are talked are rather startling. The new Automobile Club has apparently been made the basis for a scheme to float a company with a capital of $200,000,000. It is a pity that a club with such worthy social ambitions should so soon become a centre for speculation, but the fact is only another indication of the general belief in the near-at-hand change from horses

to mechanical motive power for vehicles. If such large figures have something behind them, they are not to be idly dismissed or made cause for scoffing. Ten years ago none of us thought that by this time the capital of the electric railways of America would total up about $1,750,000,000, as they now do.

And this brings us to the capitalization of electric vehicle companies, in regard to which the *Engineering News* has had something pertinent to say in a general article on the relation of motor vehicles to the stock market. With reference to one of the largest electrical organizations it says: "Under these circumstances, the stock buying public may be pardoned if it looks cross-eyed at these $25,000,000 'operating' concerns, and even raises one eyelid at their $12,000,000 parent." There seems to be a little misapprehension here, and most decidedly an underrating of the ability of electricity to hold its own in the new competition. The point is that the present capital issued in the case of the territorial companies is in every case but a fraction of the sum named, but it would hardly be worth while to go back for an increase every time the business grew so as to need it. It is not a new feature of finance for companies to carry stock in the treasury till it is needed. And so far from expecting $25,000,000 to do all the electrical vehicle work in New York State, for example, we hope and expect to see the amount many times that figure. Obviously, too, the capital of the parent company must bear some proportion to its possible business, and if the owners think they can go on paying dividends on $12,000,000 or even $24,000,000 we can only trust in all sincerity that they will find all their hopes realized just as we would like to see not $12,000,000, but $120,000,000 all actively employed in electric automobile work. If present indications are any criterion, the day is not far distant when the business will represent figures alongside which the present will seem very moderate. Our contemporary thinks that steam and gasoline vehicles are so cheap as to place electric vehicles under a severe handicap, because of their cost. We think differently, and the course of events will show who is right. Meantime those who want steam and gasoline vehicles are welcome to them at any price, so far as we are concerned, and we do not find any electric automobile manufacturers worrying one little bit about the strain that such competition imposes on them. We deprecate sensational capitalization as much as anybody, but the art to-day is growing at such a rate it needs all the capital upon which it can lay its hands. Some of the investors will doubtless lose their money. Others will reap a reward for their courage and foresight. They all go in on their own initiative, as others did into telegraphy, telephony, electric lighting and street railway work.

New Orleans Electric Pumping Plant.

Until recently New Orleans suffered under the reproach of being alone among the great cities of the civilized world in the lack of a drainage system—a reproach under which it might yet labor had not a reform government considered it a first duty to provide for the crying need. Elsewhere in this issue we print a full account of the system as now partly completed, and which furnishes another illustration of the manifold uses to which electric power may be put in virtue of its ease of distribution. As will be seen, bids were called for both steam and electric plants, but as the system of drainage decided upon provided seven pumping stations distributed over the city, the advantages of a power that may be generated in quantity at one point and cheaply distributed to the various pumping points, led naturally to the preference of electricity over steam. Aside from considerations of intrinsic economy and efficiency of operations under the conditions applying, are the no less important advantages pointed out by Mr. Reed in the article—the control of the whole system as a unit from a single point and under the management of a single experienced head, and the flexibility which admits of the system as a whole being run economically, notwithstanding the varying loads at the different pumping stations. The electrical features of the plant have been worked out in a manner which reflects much credit on those charged with their study, and we congratulate the good citizens of New Orleans upon the possession of a drainage system which, though belated in appearance, is an engineering work of which they may well be proud, and to which we are glad to point as a model of electric power distribution on a large scale.

Submarine Telegraphy.

In another column we print an abstract of a patent granted last week to Prof. Elisha Gray, on a new system of submarine telegraphy. As will be seen, the system proposed is an extremely interesting one, both as a whole and with respect to some of its details. The method consists, briefly, in exciting magnets in relation to a bell, with currents of a frequency corresponding to the distinctive vibratory rate of the bell; the magnetic force thus tuned is caused by appropriate means to produce at regular intervals a deformation of the shape of the bell, thus resulting in its vibration. The receiver consists of a stretched steel plate located at a distance and tuned to respond to the vibrations transmitted through the water; a telephone attachment in turn taking up the vibrations, which may be broken in continuity to correspond to the Morse code, and rendering them audible in the ordinary telephone receiver.

As is well known, in sounding a bell by means of a blow, much of the energy applied is expended in setting up objectionable overtones. By the electromagnetic means proposed by Professor Gray, only such vibrations will be set up as correspond to the normal note of the bell, a pure tone thus being produced which, indeed, the inventor calls "a new sound." The patent gives no indication as to the distances through which messages may be transmitted in the manner proposed, and practical experiments on the system will be looked forward to with much interest. An ingenious application of the method to a governor is described by the inventor, a modification of which should be applicable to the determination of frequencies. As applied to the purpose mentioned, the bell sounds only when the speed of the alternator corresponds to the normal vibratory rate of the bell, and a delicate governing attachment to the machine may be adjusted until the sounding of the bell indicates that the proper speed is secured, after which the mechanism is presumed to automatically maintain such speed.

Standardization Rules of the American Institute of Electrical Engineers.

The Rules recommended by the Standardization Committee of the American Institute of Electrical Engineers deserve to be adopted universally. They received the careful and continued attention of the committee for nearly two years, during which time criticisms and amendments were invited from all the principal electrical manufacturers and consumers. By uniting upon the American Institute Standard Rules, all doubt as to the meaning of such terms as "regulation," "heating," "rating," etc., becomes practically banished. All competitors know exactly the conditions with which they have to comply when making proposals or following specifications under American Institute Standard Rules, and all purchasers and engineers know what to expect from machinery under the same conditions. Heretofore it has been necessary for each individual to ascertain just what each manufacturer or consumer meant and intended by such phrases as those we have quoted, with the result that much confusion and misunderstanding existed. We do not mean to say that we con-

sider the rules as flawless or beyond all improvement. Even assuming that such was the case, they would necessarily require to be improved and modified in a few years, under the rapidly changing conditions of an industry that is making such rapid progress as the electrical industry. But we are firmly of the opinion that even if the American Institute Standard Rules were very faulty, it would be desirable to adopt them universally for the sake of general uniformity, and to correct the errors by concerted representation at some fitting opportunity.

Taken in its entirety, we think the American Institute Standard Rules form one of the best pieces of work that the Institute has performed on behalf of the electrical community, and that the best appreciation which the community can offer the Institute in return is to fall in step with the general adoption of the same. In fact, we notice that this movement is already well under way, and that several of the prominent electrical manufacturing companies have recently introduced these rules into their engineering and commercial practice.

Among the American Institute Standard Rules we notice incidental recommendations upon phraseology. Thus, the word "transformer" is used in connection with stationary induction apparatus; whereas, the word "converter" is appropriated to the apparatus which has so frequently been called a "rotary transformer" in the past. There can be no doubt that "converter" is the much shorter and better term to employ. The term "dynamotor" is also carefully distinguished from the term "motor-generator," and both from the term "booster."

The Passing of the Mirror Galvanometer.

A very noticeable feature of modern electrical development is the general disappearance of the original form of the Kelvin mirror galvanometer. In this form, as is well known, a suspended system of one or more small magnetic needles of watch spring is supported by one or more silken fibres within the magnetic field of coils of insulated wire, and a mirror attached to the suspended magnet system enables the deflection of the magnets to be observed. The instrument was fundamentally very simple, very sensitive and very useful. Before the dynamo came into existence, this type of galvanometer flourished in all electrical measurements. When dynamos spread and multiplied, the convenience of the galvanometer for measuring purposes waned. In the first place, the mirror galvanometer was not a direct-reading instrument, in the sense that it required to be calibrated and the readings reduced to C. G. S. measurement, or to the practical system of units, through the medium of this calibration; and, moreover, owing to its sensitiveness, the calibration was rarely to be depended upon for many hours in succession, a fresh calibration having to be made with each day's work. The instrument was also far from being portable, and great difficulty used to be experienced in employing it in workshops, owing to the effect of mechanical vibrations which kept the spot of light dancing in fiendish glee over the scale. Mirror galvanometers were sometimes suspended from the ceilings of testing rooms by elastic cords of soft rubber, for the purpose of absorbing these vibrations. The worst trouble of all, however, was due to stray magnetism. Not only were the field magnets of the dynamos capable of making their presence obtrusively felt, at a distance of many meters, upon mirror galvanometers, but even the strong currents carried from the dynamos invaded the magnetically sacred limits of the testing room and set authority at defiance. For a time, the galvanometer sought refuge by retreating into a cylindrical shell of soft iron, an inch or more thick, but the all-pervading magnetism found its way to a disturbing degree even through such iron walls, and at last the mirror galvanometer capitulated unconditionally.

The D'Arsonval type of mirror galvanometer at this juncture came to the rescue, and has now largely occupied the place of its predecessor. The little suspended magnet of the latter has grown out of all proportions, and has so far swallowed up its original environing coils, that the latter are now found delicately suspended between the polar jaws of the usurper. The sensibility of the instrument has suffered by the change, because the mirror and magnet used to be so light; but, on the other hand, great sensibility is rarely, if ever, needed for practical purposes of measurement, while the new instrument usually ignores magnetic changes in its neighborhood and laughs at dynamos or motors.

The same thing is true concerning tangent galvanometers. In the days of the early dynamo the most conveniently reliable way of measuring the strength of a current, weak or strong, was by passing it through a tangent galvanometer in which the electromagnetic force of the coil was compared, at its centre, against the horizontal component of the earth's local magnetic intensity as indicated by the deflection of a little magnetic needle. The reading of the instrument became converted into amperes, as soon as $\mathfrak{H}$, the earth's horizontal component at the instrument, was known, and great importance was laid, therefore, upon the determination of $\mathfrak{H}$, which was measured by special apparatus to the third or even fourth decimal place. At the present time, we think it is doubtful whether 1 per cent. of the men engaged in making electrical measurements know the value of $\mathfrak{H}$ in their town to within 20 per cent. of its mean amount, and the measurement of $\mathfrak{H}$ has died away into the obscurity of a few isolated magnetic observatories.

These observatories in their turn, have felt the magnetized iron glove of the electrical engineer, and have suffered from its grasp. Not many years ago, a magnetic observatory could be built in almost any city by rigidly excluding iron from the observatory structure and its immediate neighborhood. The inmates practically foreswore the use of iron, and all intruders were searched for iron pocket implements on entrance. At the present time, we do not know of any city which contains a magnetic observatory that is in working order. The all-pervading trolley has driven them into exile. It has been shown that the magnetic influence of the trolley system currents may extend for several miles from the car track, and that although part of this influence is attributable to the magnetic influence of the loop of conductor formed by the overhead trolley and return track, the greater part is usually attributable to return currents in an extended sheet passing through the ground back to the central station. Since there is no known means, at the present time, of separating the magnetic influence of trolley systems from the magnetic influence of the earth, the records of the magnetic instruments are rendered practically valueless. Much outcry was raised at first by magneticians in consequence of this ruthless invasion of their precincts, but it is manifestly more desirable that a few observatories should be chased into the wilderness than that the community should suffer from the exclusion of the trolley system It is not that the magnetic records are valueless. Far from it. Any scientific record, and particularly any magnetic scientific record, is of great value directly to science, and indirectly to the community, but the direct value of the trolley system to the community is far greater, and it is useless, in the world of change, to repine at the inconsistency of Fate. The only comfort that magneticians may find is that in the remote regions to which their observatories become banished, they will be less likely to be disturbed by careless visitors, and that the wealth which the trolley systems brings to the humanity dwelling within cities may enable five observatories to be built for every one that the trolley immolates.

Invalidity of Magnetic Blow-Out Patent.

Judge Edward B. Thomas, of the United States Circuit Court for the Eastern District of New York (Brooklyn), rendered a decision on Nov. 10, at final hearing, in which he held that the Elihu Thomson magnetic blow-out patent, No. 283,167, dated Aug. 14, 1883, is invalid and void because not involving patentable subject matter; and the bill of complaint in Thomson-Houston Electric Company vs. Nassau Electric Railroad Company, based on that patent, was dismissed. This is the broad basic magnetic blow-out patent that is so well known in the art. The Nassau Electric Railroad Company was the defendant, by the Lorain Steel Company, whose apparatus it was sued for using. The case was argued by Betts, Betts, Sheffield & Betts, for the complainant and W. H. Kenyon and G. J. Harding for the defendants.

After entering into the details of the question at issue, Judge Thomas remarked that if it was known that the arc formed in a circuit disconnected by any means could be dispelled by a magnet, nothing was added to such art by providing that the circuit should be broken by specified means; the opening of the circuit being a mere incident to operation. It would be too broad a claim to assume that the patentee had contributed to the art of breaking electric circuits, and the claim for economy in breaking by means of a switch meant little.

"The conclusion is therefore reached that if the extinction of such arcs by means of magnetism was known before the patent in suit, nothing has been added to any art by applying the knowledge to a circuit broken by a switch, the precise reason being that the switch is not exposed to, or rescued from, danger by reason of its being part of a switch, but because it is a segment of an electric conductor. Therefore, no economical advantage results to the switch as such, but to the conductors as such, and this was the exact event in the prior art." "In fact," said the judge, "the complainant would seem to differentiate the prior art from the patent in this; that the patentee showed that a magnet would not only extinguish the arc formed by a current of considerable power, but would do it so quickly as to render it harmless. If the prior art showed that a magnet would extinguish an arc, it would seem to follow that it was known that its extinguishment would stop its burning. The nature of the arc is to burn; the necessary result of the application of the magnet is to stop the burning. This nature and result existed as much before the patent as thereafter. It was well known that a magnet would extinguish an arc. For such purpose the patentee used it in his combination. If the invention suggests anything new it is that the magnet will do its work before injury occurs. This is but a statement that the magnet has the power of acting more quickly than before, although there is no evidence of any limitation upon the celerity of its action at the earlier period. There is no change in the manner of applying the magnet, no new mode of operation, no new result save in degree. The proximate mechanical results are the same in their nature. In Ansonia Brass & Copper Company vs. Electrical Supply Company, 144 U. S. 11, the court said: 'A mere carrying forward or new or more extended application of the original thought, a change only in form, proportions or degree, the substitution of equivalents, doing substantially the same thing in the same way by substantially the same means with better results is not such invention as will sustain the patent.' The fact is that the patentee does not necessarily describe but in practice he uses a magnet stronger and capable of instant extinction of the arc. This indicates increased capacity for usefulness, but nothing of invention. Ansonia Brass & Copper Company vs. Electrical Supply Company, 144 U. S. 11; Edison Electric Light Company vs. Westinghouse Company, 50 F. R. 490; 63 F. R. 588; Woodbury Planing Machine Company vs. Keith, 101 U. S. 479; Roberts vs. Ryer, 91 U. S. 267.

"Under the concession of the complainant illustrated by the quotations from the brief given, it is unnecessary to review the prior art. The influence of the magnet, to the extent stated, was, and for many years had been, a part of scientific knowledge. The patentee applied it to what he called an electric switch or commutator, which for the purposes of this decision has been regarded as a stated means of opening or closing an electric circuit with a segment of the conductor incorporated in the switch. Long afterward the operation of trolley cars required the quick extinguishment of electric arcs, on a scale not before contemplated. Thereafter Professor Thomson devised a structure, which involved the use of a magnet to extinguish electric arcs. He had formerly embodied this old art in a patent, and in consequence at the later period sought to monopolize it, without any legal justification, as it appears to the court. Since the letters in truth reveal no use, function, mode of operation, or manner of application new in the art, the complaint should be dismissed."

The New Independent Telephone Fight.

Following up their plans for the formation of a new corporation, the organizers of the movement against the American Bell Telephone system, with regard to whom various data and reports have been referred to in these pages during the past fortnight, incorporated in New Jersey last week as the Telephone, Telegraph & Cable Company of America, with a capital stock of $30,000,000. The directors and incorporators are the same, W. J. Latta, Martin Maloney and James E. Hays, all of whom are well known in connection with Widener-Elkins-Whitney interests. The officers of the company, after the stockholders' meeting in Jersey City on Nov. 13, were announced to be William J. Latta, president; George F. Hawkins, secretary, with these and Messrs. Hays and Maloney as directors.

The national plans of the company have now to be unfolded, but it is understood that they have already made arrangements in various quarters such as Boston, and with larger exchanges using the Kellogg apparatus, such as St. Louis, Indianapolis, Pittsburg, Cleveland and Baltimore. On the other hand, Mr. Albert G. Wheeler, president of the Illinois Telegraph & Telephone Company, of Chicago, asserts that four-fifths of the independent companies will stay out of the combination. Mr. Wheeler says that not only will the Chicago Company refuse to join, but that Philadelphia and some of the other larger cities, where independent telephone plants are already in operation, have refused to go in.

Mr. James E. Keelyn, president of the Western Telephone Construction Company of Chicago, is another strong opponent of consolidation. Mr. Keelyn was one of the leading factors in bringing the telephone men into a national association for mutual benefit. He declares that the leading men in the association are absolutely opposed to any scheme of consolidation that will subordinate their interests to those of any existing monopoly. This hardly agrees, however, with the fact that Mr. G. W. Beers is associated with Mr. Latta, and that Judge Thomas and Mr. Critchfield are reported to be in full touch with him also.

There is naturally much conjecture as to the position of the Western Union and Postal Telegraph Companies and their attitude toward the new independent company. The names of Mr. Gould and the Western Union have been pretty freely used, but no evidence has yet been adduced to justify the reports. In some quarters it is alleged that the Western Union no longer holds its 40 per cent. of New York Telephone stock, but, according to the best authorities, in 1898 the Western Union owned nearly $4,000,000 of New York Telephone stock and $80,000 of the Troy, N. Y., Telephone & Telegraph stock. It is said that Mr. Gould is not personally interested in the new opposition, but that he is a small personal stockholder in the Knickerbocker Telephone Company of New York.

As to the terms or conditions upon which an alliance between telephone and telegraph interests can be found, little data of any value is forthcoming. It may be pointed out that both the Western Union and Postal have pole lines, on which, in these dull days of telegraphy, they might be glad to lease out a few pins for an honest penny. Telegraph revenues of late years have shown little expansion, and the trouble is all laid at the door of the telephone. It is whispered around electrical circles that the Postal Telegraph Company has lately been ordering cables on specifications that would answer very well for telephone work, and that the Western Union has a new 30-pair cable for the North River, whose use would naturally be telephonic.

In New York City interest centers in the relations between the Telephone, Telegraph & Cable Company and the local People's Telephone Company and Knickerbocker Telephone Companies. Both of them are now equipped with permits to use the subways, but what else they may have is largely cause for conjecture. The People's Company has been pushed by the New York Board of Trade and Transportation in its fight against the New York Bell service, and it has a list of several thousand possible subscribers, whatever that may be worth. The Knickerbocker Company has at its head the veteran telephonist, W. H. Eckert, brother of the president of the Western Union, and is understood not only to have a strong directorate and stockholdership, but to own some very valuable patents, some of which would prove extremely valuable in trunking messages.

The Electric Drainage of New Orleans.

BY LYMAN C. REED.

For many years the City of New Orleans has been awake to the necessity of having an efficient drainage system. To secure its effective accomplishment Maj. B. M. Harrod and Henry B. Richardson, of New Orleans, and Rudolph Hering, of New York, were appointed to draw up specifications and plans to solve the difficult and unique problems involved. The civil engineering problems were of a more difficult nature than those of determining and designing the machinery and nature of power to be used.

When this work was begun there was no reliable data on hand

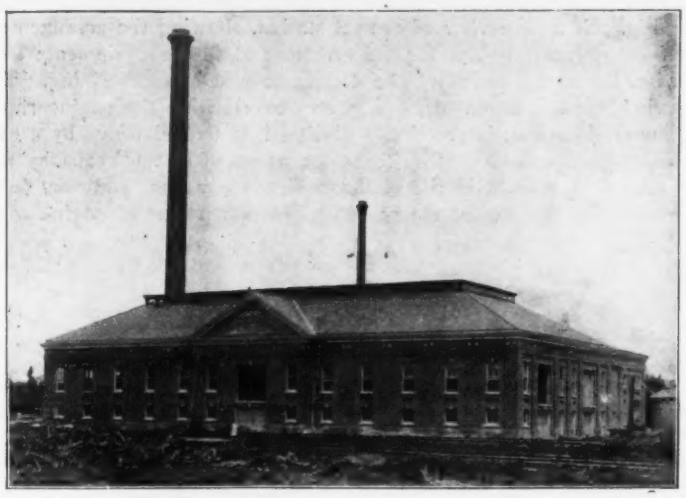


FIG. I.—CENTRAL GENERATING STATION.

which gave the amount of rainfall for the various sections of the city, or the rate of run-off to be provided for by a system of drainage canals. Recording rainfall gauges were therefore installed at various points, and the run-off was estimated as nearly as possible from the data thus obtained, and also from additional data obtained from the then open canal system. An important factor was the severity of some of the storms in this climate which a drainage system has to handle, imposing tremendous temporary demands on canals and pumping stations at such times. After thorough topographic and hypsometric surveys had been made, a set of curves (Fig. 9) was established covering every portion of the drainage area. The highest portion of the city lies adjacent to the river, and the lowest portion some 9000 feet away, parallel to it, and forming a basin between the river and Metairie Ridge, which runs parallel to the lake and forms a natural dividing line between the city and the swamp beyond. The relative altitudes of the above are clearly shown in the vertical section of Fig. 3. The gradual slope from an average of 33 feet at the river and 25 feet at Metairie Ridge to 20 feet at the basin at Broad Street, formed a natural plan for draining the included areas, which was utilized by feeding branch canals and pumping stations at such times. Fig. 6 shows a plan view of this main canal and branches, giving a very clear idea of the system as a whole.

The water flows through the branch canals into the main canal by gravity, but as the main canal lies in a flat basin, it has no natural flow, and, therefore, an artificial slope had to be given it. This artificial slope was divided into five sections, and pumping stations 1, 2, 3, 4 and 5 are placed at the end of each section respectively, at which points the water is lifted by centrifugal pumps and discharged into the sections beyond. Each pumping station is designed to handle the water of its section, and whatever surplus is received from the preceding section. The easiest means for disposing of the drainage water lies in emptying it directly into Lake Pontchartrain.

The first washings from the street, however, being very foul, it was feared that the Lake would become polluted, so a longer route was chosen via Bayou Bienvenvue to Lake Borgne, distant some 30 miles from the city. But, after the first run-off takes place and the water become comparatively clean, it is planned to empty by means of branch relief canals and pumping stations 6, 7 and 8, the main body of the water into Lake Pontchatrain, and thus avoid the accumulated volumes which would otherwise appear at stations 3, 4 and 5. These branch relief canals are so constructed as to act as drains into the main canal at times of ordinary flow, furnishing also a large storage capacity in the event of a sudden rainstorm, thereby giving the necessary element of time in which to allow for the starting of the pumps at 6, 7 and 8. The estimated maximum run-off in cubic feet per second is given for the different stations.

Station No. 1 receives 2738 cubic feet per second, 1750 cubic feet of which is discharged into the second section of the main canal with a lift of three feet; 988 cubic feet per second, with a four-foot life to the branch relief canal leading to station No. 6.

Station No. 2 receives 3150 cubic feet per second from all sources, delivering 2250 cubic feet to the third section of the main canal with a lift of three feet; 900 cubic feet per second to the branch relief canal leading to Station No. 7, with a lift of two feet.

Station No. 3 receives 3250 cubic feet per second, 2000 cubic feet per second going into the fourth section of the main canal, with a lift of 2.6 feet, and 1250 cubic feet per second with same lift into the branch relief canal leading to Station No. 8.

Station No. 4 receives 3000 cubic feet per second, 2500 cubic feet going into the fifth section of the main canal, with a lift of 3.5 feet, and 500 cubic feet per second, with a lift of 10.5 feet, into the Lafayette relief outfall.

Station No. 5 receives 3000 cubic feet per second, and discharges, with a lift of 12 feet, into the canal leading to Bayou Vienvenue, from when it finally goes to Lake Borgne.

Station No. 6 receives 1853 cubic feet per second, and discharges with a lift of 12 feet into Metairie Relief outfall.

Station No. 7 receives 1000 cubic feet per second, and discharges with a 13-foot lift into Orleans relief outfall.

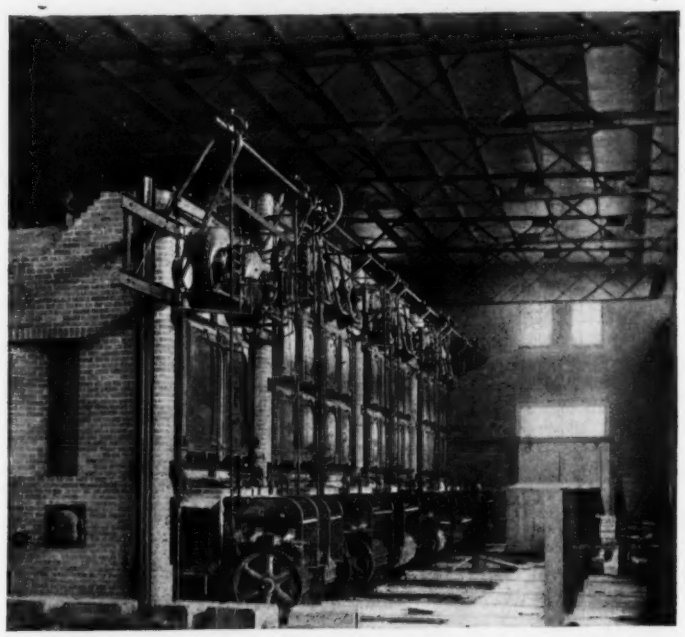


FIG. 2.—BOILER ROOM.

Station No. 8 receives 1550 cubic feet per second, and discharges with a 10.5 lift into London relief outfall.

The daily flow at Stations Nos. 1, 2, 3, 4 and 5 is estimated at 38 cubic feet per second, and provision is made at each pumping station on the main canal, when the volume of water does not exceed this, to hold the head which the pumps make, allowing a natural flow over these heads to Station No. 5, where it is finally pumped into the main outfall.

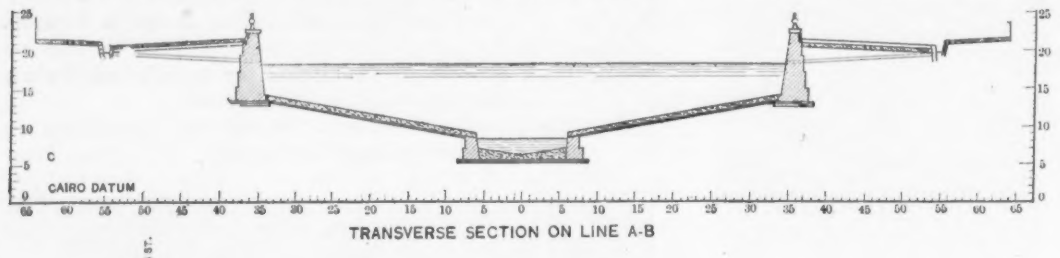
Profile and sectional views of the main canal are shown in Fig. 3, giving the slope of the canal for daily flow, and also the flood line slope for the various sections. This canal is uncovered, and its construction may be seen in the transverse section.

In the construction of these canals, both open and closed, many difficulties were encountered, the character of the soil making necessary that all calculations be on the basis of hydraulic thrust in excavation and lining. The latest improved steam shovels were employed whenever possible, and all hauling of material and excavations was by means of a movable trolley road, current for which was taken from adjacent trolley systems. All branch canals except in the outlying districts are covered and lined. The branch canals are fed by sub-drains under the sidewalks, having gratings to receive the surface water from the street.

For other illustrations accompanying the article, see insert sheet.

Bids were received for both steam and electric operation of pumps, and all conditions of economy and efficiency of operation and cleanliness being considered, electrically operated pumps fed from one central power plant were finally decided upon as being preferable to individual steam pumping stations. This plan, furthermore, enables the entire system to be run as a unit controlled from one point, and under the management of one experienced head, instead of running independently each pumping station, while the power for light loads has the advantage of being economically generated at one point instead of being inefficiently generated at many points. As is seen from the foregoing illustrations and description, the constant duty demand is very small compared with the maximum. To meet this condition, the generating plant and the pumping stations on the main canal may be considered, as will be shown later, as divided into two parts, one for light and the other for heavy duty; auxiliary stations Nos. 6, 7 and 8 may be classed as for heavy duty only.

The central power plant is located in close proximity to pumping station No. 4, and while this is not the geographical center of distribution, it is practically the mean center of electrical distribution. Three-phase alternating currents generated at 3300 volts and 25



TRANSVERSE SECTION ON LINE A-B

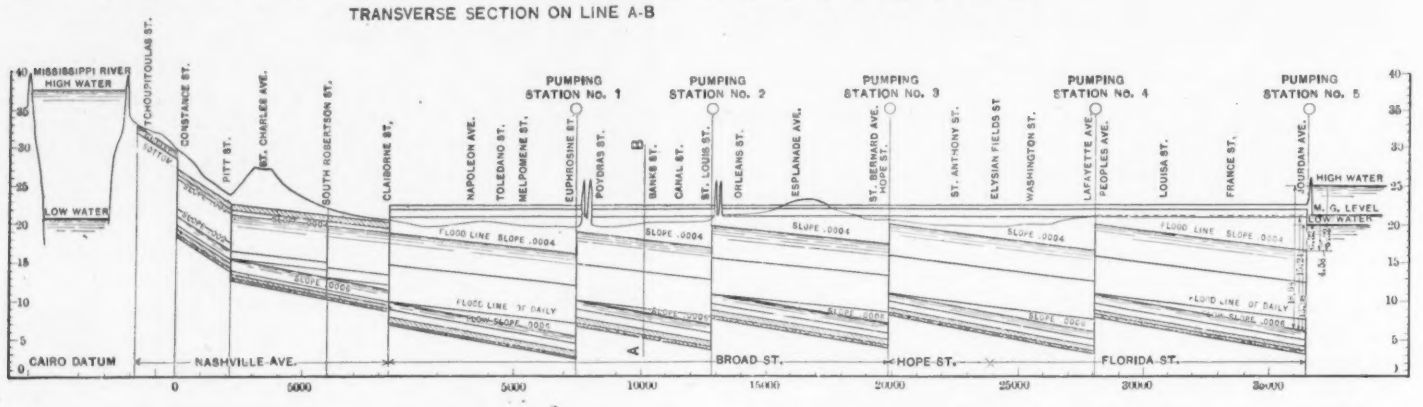


FIG. 3.—VERTICAL SECTION OF CENTRE LINE OF MAIN CANAL.

cycles are used for operating the system. The pump motors are run synchronously without reduction in voltage, and the system is always maintained in balance by having all the motors fed from one common bus at the central plant.

The present contract includes the completion of Station Nos. 2, 6 and 7, with No. 2 only partially operated, together with the necessary central station equipment. The power house building is complete, together with the present equipment; engine foundations are also built for the full complement of power for the completed system.

The power ultimately required in pump or water horse-power for the various substations is as follows:

Station No. 1	471-hp
Station No. 2	534-hp
Station No. 3	370-hp
Station No. 4	587-hp
Station No. 5	1364-hp
Station No. 6	796-hp
Station No. 7	796-hp
Total	4918-hp

The present requirements are as follows:

Station No. 2	193-hp
Station No. 6	796-hp
Station No. 7	796-hp
Total	1785-hp

The central station is situated at the junction of two railroads, and is conveniently located with reference to two important factors in economical operation—cheap coal and free water.

The plant presents a very pleasing appearance, and is in striking contrast to the surrounding swamp. The ground is soft and marshy and the foundation is laid on piles, driven 40 feet deep and spaced 4 feet by 3 feet between centers under weights, and 4 feet by 4 feet between centers under the walls and central columns. The plan of capping and decking is shown in the cross section of engine and boiler room, Fig. 8.

Fig. 1 is a view of the exterior of the central station looking northwest; the tall steel stack, 175 feet high by 9 feet 6 inches at base, is shown at the left, and the small stock, 100 feet high, in the center of the building. The large stack furnishes the draft for six boiler units, the small stack for two units. The object of this division will be dwelt upon later.

Fig. 7 is a plan view of central station, showing the arrangement of boilers and engines for the present and future equipment; likewise, the arrangement of the condenser and exhaust piping. The switchboard is mounted on a gallery overlooking the engine room. The engine room is practically divided into two divisions by a central row of columns. Two traveling cranes of 10 tons' capacity will be used, as shown in the sectional view, only one, however, being placed for the present equipment. The dimensions of engine room are, length, 178 feet; breadth, 90 feet; boiler room, 178 feet by 45 feet, with a fireproof wall separating the two rooms.

The plan of steam piping is such as to allow each boiler unit to be separately connected to the main header.

The present installation of engines in the power station consists of six units aggregating 3750-hp, divided as follows: Three 1000-hp horizontal cross-compound Allis-Corliss engines, having each a 750-kw three-phase alternator hung directly on the engine shaft, revolving at 94 r. p. m.; one 500-hp horizontal cross compound Allis-Corliss engine, with a 375-kw three-phase alternator mounted in like manner, running at 107 r. p. m.; two 125-hp horizontal tandem-compound Allis-Corliss engines, directly connected to 75-kw three-phase alternators. Fig. 4 is a view showing a portion of the large units in the foreground and smaller units in the rear, taken during construction.

The reheater coils and standard Allis condensers are placed in between the high and low-pressure cylinders of the large units, the arrangement being shown in the plan view of the engine room. The condensed steam is passed through a set of coils, not shown in the plan, over which the low pressure exhaust passes, raising the temperature of the condensed steam on its way to the common boiler feed header. The discharged circulating water of the condensers flows through a pipe running in an arch of the engine foundations, and discharges into an open circulating canal, which makes a long detour of possibly a half mile, whereby the water is cooled ready for further use by the condensers.

The engines receive steam from a header, traversing the entire length of the building, supported by tie rods from the roof trusses. There are no valves in the entire length of the header, but one valve is placed on the steam lead pipe of the small battery of boilers, just

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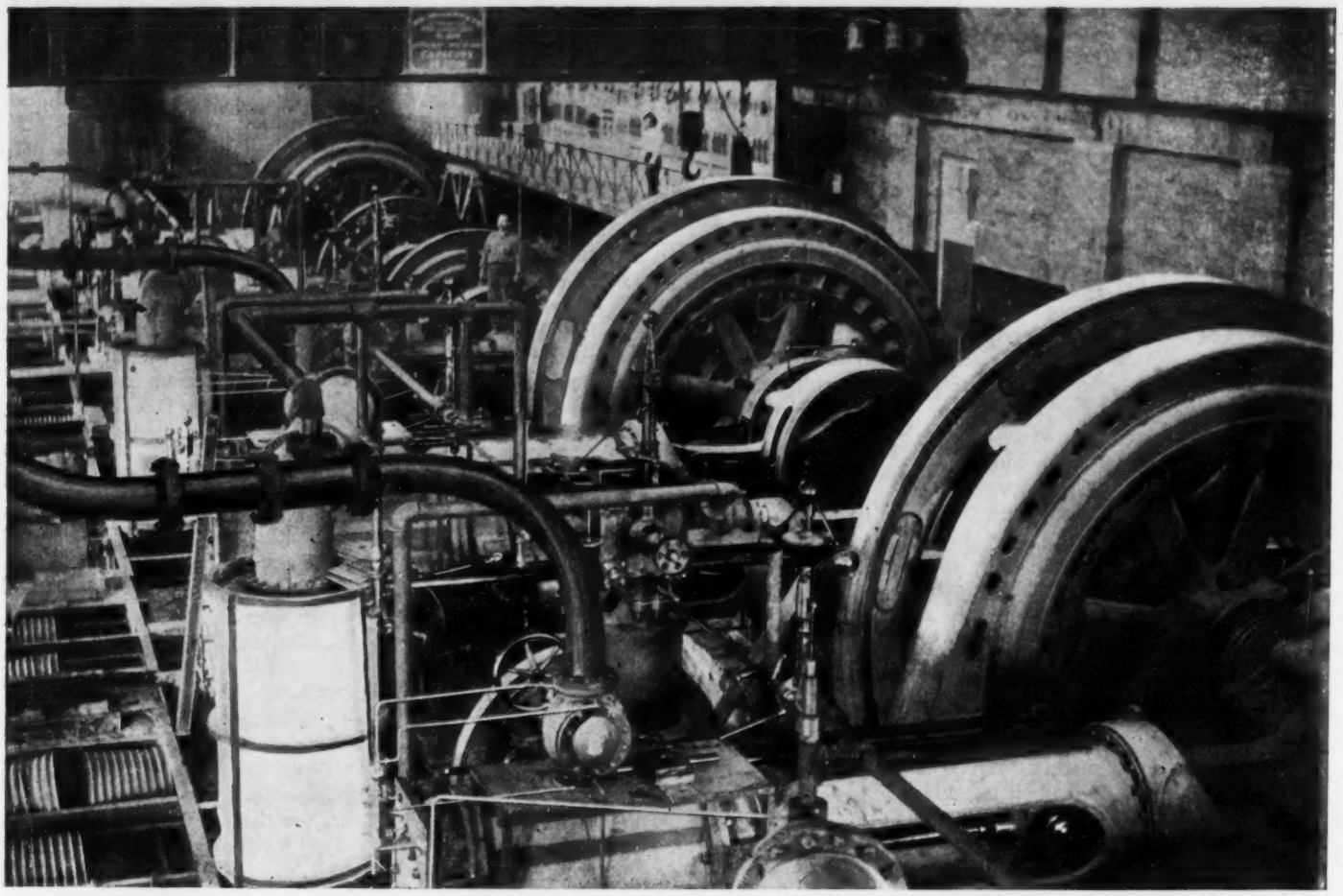

Fig. 4.—View in Engine Room, Looking Northwest.

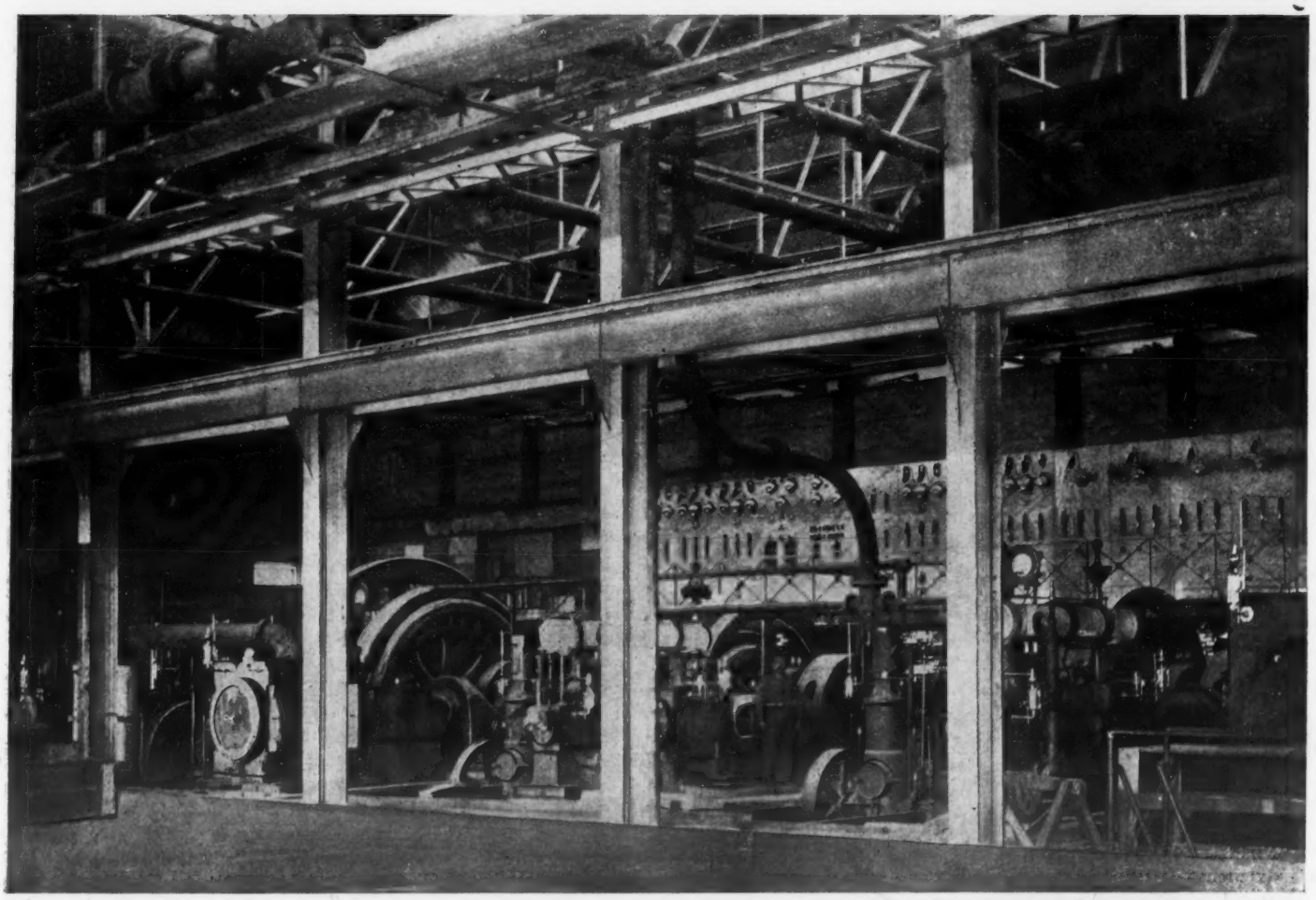

Fig. 5.—Portion of Engine Room.

before entering the header, cutting it off therefrom; and one boiler valve is also placed on each steam lead of the other boilers. Whenever a heavier demand is made on the system than can be met by the constant-duty engines fed by the small battery of boilers, the whole header, 160 feet in length, is filled with live steam to the engine throttles. The two small constant duty engines, generators, and their feeding battery of boilers are installed to permit of economical fuel consumption on light load, thus obtaining a greater efficiency than would be possible with the large units lightly loaded.

The engine room floor is some eight feet above the ground, and in the basement thus formed, and directly under the live steam header, is carried the atmospheric exhaust header, which runs the entire length of the building, and receives the exhaust of all the engines. The boiler feed pumps are two in number, and are located in the basement of the engine room, near the boiler room wall. The pumps are operated by steam, and are furnished with valves to enable them to feed cold or hot water or both as the need may be. Four direct-connected marine type exciter sets complete the engine room equipment.

The boiler room is large enough to accommodate the entire complement of boilers needed for the complete system, but for the present needs only eight batteries are installed, aggregating 2330 boiler horsepower, divided into six 355-hp units and two 100-hp units. As stated above, the two 100-hp units are for constant duty, and are provided with a separate stack. All the boilers are Babcock & Wilcox, double deck, and fitted with their automatic chain strokers driven by a small single acting vertical engine placed on top of the boilers. Fig. 2 gives a fair idea of the boiler installation; the arrangement is shown in the plan and sectional views. The small upright posts at the right are supports for the coal bins, and the coal is dumped from cars through the windows into the bins, whence it is handfed to the boilers. The coal cars are sidetracked on a switch from the adjacent railroads. The boilers are provided with front feed only, the blow-off pipes being carried in a pipeway under the floor at the rear of the boilers. Each boiler is equipped with a separate steam lead to the main header in the engine room, the pipes passing through the engine room wall above the switchboard, traversing half the width of the engine room before reaching the header.

All the generators are of the General Electric revolving field type, and furnish three-phase currents at 3300 volts and 25 cycles. The cycles were chosen thus low for the reason that the current is primarily for power purposes. The generators are operated in parallel, and feed a common bus at the switchboard. The board is provided with two sets of high-tension busses, so that in case of accident the operation of the system will not be interfered with; the two sets of low-tension exciter busses are also in duplicate for reasons of safety. The leads from the generators to the board are run open under the engine room floor, and are supported on triple-petticoat glass insulators placed on wooden supports. The switchboard is of handsome gray marble, and is of the standard General Electric three-phase type. The panels are divided into two sections, the upper portion carrying the high tension, and the lower portion the excitation current. A view of the board in Fig. 5 shows at the left the three generator panels for the small units, each panel containing fuse blocks, one ammeter for alternating current, one for exciter direct current, and an indicating wattmeter for the generator. Spring break single-pole switches are used on the high tension current, and the usual type of knife switch for the exciter current.

The next two panels are for exciter control and are fitted with the usual ammeters, voltmeters, etc. Following these is the transformer panel, which controls the transformers used for lowering the voltage for two rotary converters, which furnish direct-current at 125 volts for the station lighting, crane hoist and other motors. Panels for the 750-kw generators follow, fitted in like manner to the panels for the smaller high-tension units. Five feeder panels complete the present board, each panel containing one ammeter and three controlling switches. On the rear of each of these panels are located Wirt lighting arresters on the feeder wires. Since the system is always in balance, only one ammeter is used to indicate the current on each feeder.

The pole line is constructed of best heart yellow pine poles, 14 inches by 14 inches at butt and 10 inches by 10 inches at the top, and 35 feet high.

The insulators are triple-petticoat glass, tested for 10,000 volts. Wherever firm ground is obtainable, the poles are set in concrete, but for a considerable distance along the railroad the pole line traverses swamp land, and here square piles, 40 feet long, were driven 30 feet deep, and the poles bolted thereto. Conductors are insulated wherever contact is possible with foreign wires; all other portions are bare. The pole line follows the route shown in Fig. 6, the feeders to station No. 6 being two sets of No. 3-0 B & S copper, running a total distance of five miles. The feeder to No. 7 is 3½ miles long, with two circuits of 2-0 B & S copper. Feeder No. 2 is three miles long, with one circuit of No. 3 B & S copper. The line losses on the above for full load are for No. 6, 9 per cent.; No. 7, 11 per cent., and No. 2, 9 per cent. The constant duty loss on feeder to No. 2 is only 3 per cent. It will be noticed here that the operation of the system alters the final plan of operation, in that station No. 2 will, for the time being, carry the constant-duty load instead of station No. 5.

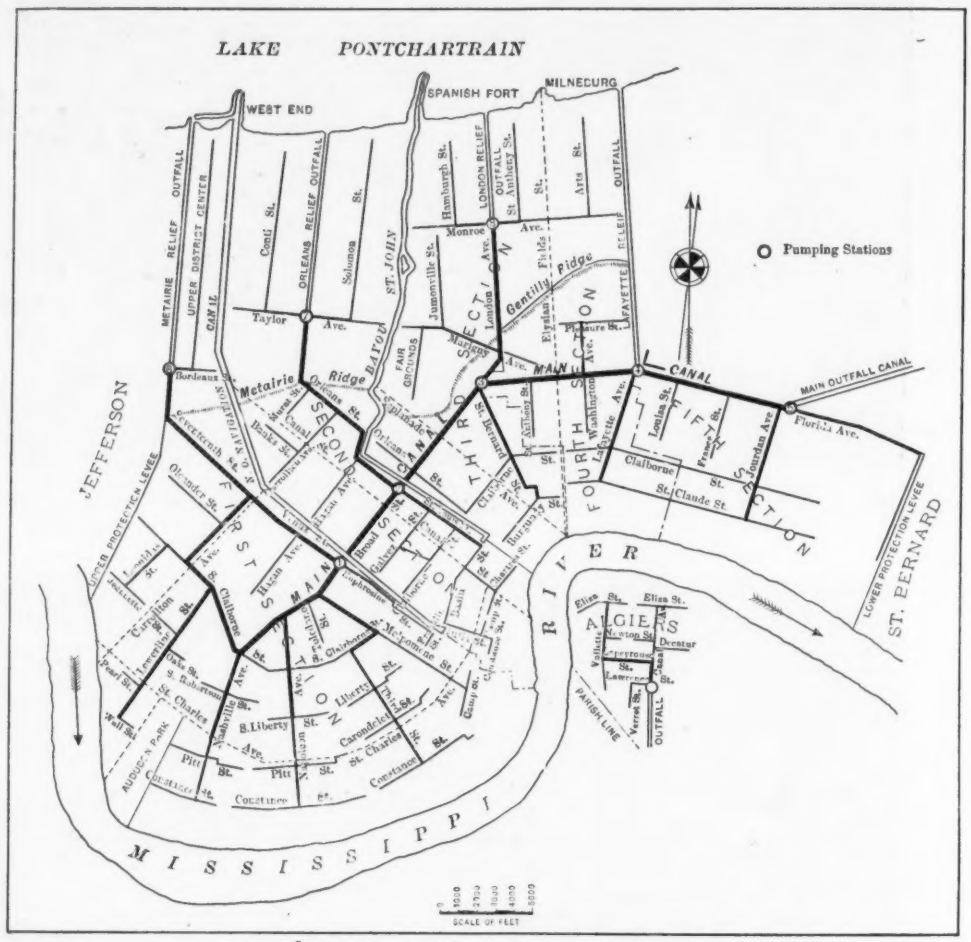

FIG. 6.—PLAN OF MAIN CANAL AND BRANCHES.

As the general features of all the pumping stations are the same, a description of No. 2 will suffice, it being entirely complete. The building is similar in construction to the central power plant, as shown by side and end elevations, in Fig. 10. A traveling crane of five tons' capacity traverses the entire length of the building. The three centrifugal pumps are driven by direct-connected three-phase synchronous motors, the arrangement being shown in sectional view. The horizontal revolving fields of these motors are keyed to the vertical shafts of the pumps, and their armatures are supported on I-beams placed across the top of the wheel pits, the bottom of the armature castings being flush with the floor. One 40-hp motor running 214 revolutions, operates the constant duty pump, lifting 40 cubic feet of water per second five feet. Two 125-hp units, running

at 167 r. p. m., lift 500 cubic feet per second through three feet to the discharge. The plan view shows the relation between the present and future requirements.

The remaining apparatus consists of one compound cylinder pump directly geared to an 800 G. E. railway motor, operated by 125-volt direct current. This pump is for the purpose of emptying the pits of seepage water before starting the pumps, as the motors have not sufficient torque to start readily under this dead weight of water. Five direct-current 10-hp motors, of 125 volts, are directly geared to mechanism for operating the gates, the positions of which are shown by indicators on the wall. The plan of operating the valves shown in section is not followed. The feeder wires are brought to a receiving panel on the switchboard, which is similar in construction and finish to the one in the central station. The entire current consumed in this pumping station is registered by a recording wattmeter placed on this receiving panel, and three spring break switches connect the feeders to the high-tension bus running the length of the board. Three motor panels, one exciter panel and one transformer panel complete the board. The two exciters are rotary converters receiving current from two distinct sets of delta connected transformers, which lower the high tension currents to 80 volts, from which it is transformed to 125 volts direct current for exciting the synchronous motor fields, operating the other motors, and furnishing lights for the building.

The calculated efficiency of the entire system may be roughly stated as lying between 50 and 60 per cent. of the power generated at the central station. It remains, however, for the elaborate tests which are to be made to determine the actual efficiency.

In the foregoing limited description of this vast piece of engineering, many interesting details are necessarily omitted. The prominent and distinctive features are given, the most noteworthy from the electrical standpoint being the concentration into one central generating plant of the power required for the operation of widely scattered drainage stations. Another feature is the employment of high-tension three-phase alternating currents of such voltage as to admit of generation, economical transmission, and safe operation of motors, without the necessity of either step-up or step-down transformers. The motors and pumps for this system had to be specially designed, since the installation of these pumping stations is unique. The civil engineering problems involved were of the most difficult nature, and their successful solution reflects the greatest credit upon the engineers of the Drainage Commission, headed by Major B. M. Harrod.

Mr. L. W. Brown, to whom I am indebted for the plans of the central station, and the engineer for the National Contracting Company, which has carried this undertaking to a successful completion, has met and solved every difficulty arising. The drainage system is now on the eve of being placed in operation, and is entirely controlled by a drainage commission, which has selected Mr. Alfred Raymond, of this city, as general manager, whose able management will insure to the citizens of New Orleans the successful handling of the drainage system.

Warsaw, Poland, Central Station Plant—III.

THE SWITCHBOARD.

The link between the central station and the distributing system is the switchboard. This is divided into two parts, namely, the engine and generator switchboard and the cable switchboard. At the first named we find all the switching and regulating apparatus of the generators, for throwing the same in multiple and measuring the current strength, as well as the voltmeters for the measurement of the pressure at the various points of the system. It is located as seen in Fig. 2 on the first floor of the extension and is reached by a platform built 16 feet above the engine room floor. From this point the entire room may be surveyed and the control of the system effected.

Behind the switchboard, arranged above one another, are the various bus bars for light and motor service on the one side, and for the railway service on the other. Each generator has a double switch, by means of which its current can be thrown either onto the light or the railway bus bars.

Along the east wall of the switchboard room on the first floor is the cable switchboard. This is divided into five sections, of which the two right and two left are intended for the light and motor service and the central one for the feeders of the projected railway system. This section will accommodate from 4 to 6 feeders; the four sections intended for light cables will accommodate a total of 20 main feeders.

SWITCHBOARD DIAGRAM.

The entire arrangement of circuits on the switchboard is shown on Fig. 4 on which we further find:

(*a*) The connection of the alternators and their exciters to the switchboard and their connection to the bus bars for either light or railway service.

(*b*) The connections of instruments and apparatus.

(*c*) The phase lamps and voltmeter for parallel connection.

(*d*) The ring connection for the light and railway service to the cable switchboard.

(*e*) The subdivision of the cable switchboard and the connection to it of the feeders.

(*f*) The connection of the main feeders with the main feeding points.

(*g*) The arrangement of the auxiliary feeders.

(*h*) The arrangement of the primary circuits, the transformers and the secondary circuits.

(*i*) The installation of test wires and voltmeters for the measurement of the pressure of the generators and at various points of the circuit.

(*k*) The connection of the railway feeders with the bus bars of the transformer station.

(*l*) The connection of the rotary converters, the boosters and the charging battery.

(*m*) The circuits which will be used in case it is decided to supply the railway service with current from the transformer station, etc.

The diagram shows both poles throughout.

A smaller diagram (Fig. 5), in which one pole only is shown, is perhaps somewhat clearer. It shows the distribution of the various main feeding points over the several sections of the cable switchboard, and the safety assured by this arrangement, as well as by the employment of the ring system and the auxiliary and equalizing circuits for the entire system, is evident.

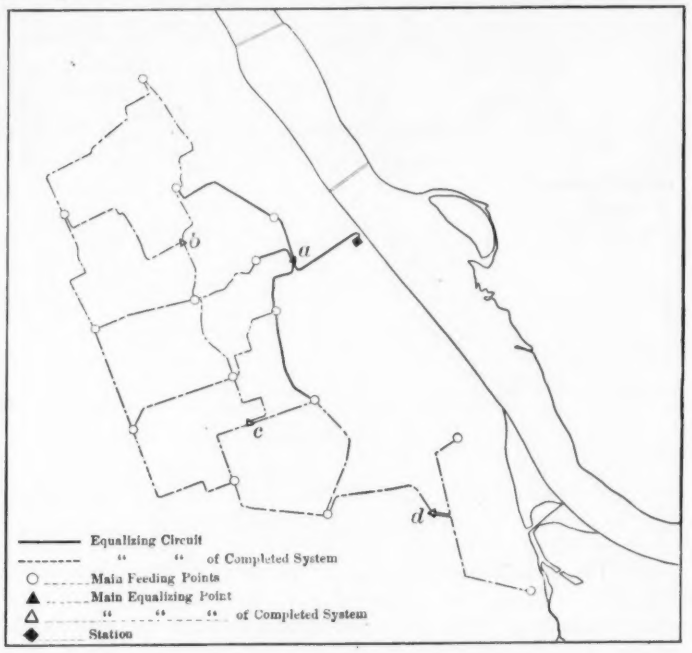

FIG. 3.—DIAGRAM OF AUXILIARY AND EQUALIZER CIRCUITS.

The two bus bars on the main switchboard permit the use of any machine either for light or railway service, or the use of groups of machines for the one or the other purpose. The double switches further enable the simultaneous use of the machines for light and railway service by connecting the two sets of bus bars. This will effect great economy and simplicity in operation especially during the day. The ring system has been adopted throughout on the switchboards and the bus bars may be divided into two entirely distinct sections.

The feeders, which deliver the electrical energy from the cable switchboard to the main feeding points distributed throughout the city, are joined into groups and connected in such a way with the four sections of the cable switchboard that no section

contains more than two cables which serve feeding points located next to or near to each other. On the contrary, each of the four sections serves main feeding points which are so located that they are widely separated from one another and are evenly distributed throughout the territory. This arrangement is indicated in Fig. 5.

While the switchboard room on the first floor of the extension contains the switchboards and all the apparatus, switches, fuses, instruments, etc., belonging to the generators and feeders, the ring circuits themselves with their switches, circuit breakers and other appliances are placed on the second floor.

A careful comparison of the four systems gave the following result: The most favorable positions for the transformers are under all circumstances the corners at street crossings; from there, according to the demand, 2, 3, 4, 6 or 8 secondary circuits can emanate from each transformer pit, without it being necessary that double cables run along any considerable distances or that T or cross-connectors are required. It is further shown that the cross-section of the feeders is not to be determined as much by the drop of pressure as the current density per square millimeter of copper cross-section.

A calculation of equivalent cross-section of cables for the four systems for the pressure intended to be used at Warsaw gave the following results:

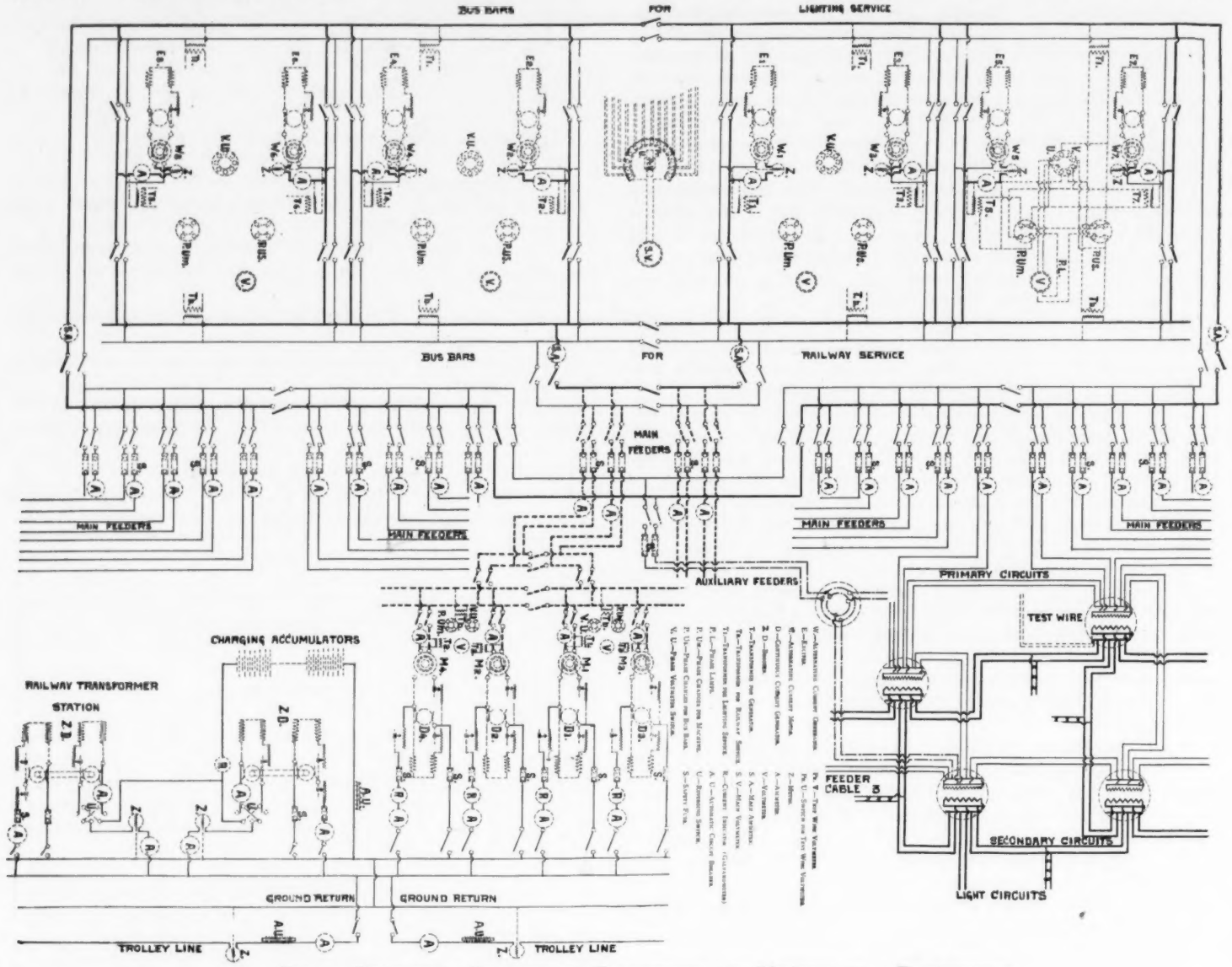

FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS AND METHODS OF DISTRIBUTION.

From the switchboard the main feeders pass down through a cable shaft to the left and right of the main entrance into the excavation below and from this point spread through the various city districts.

THE DISTRIBUTING SYSTEM.

The first problem which actually presented itself to the engineer and required solution was the choice of the system. Those which demanded consideration were the following: Single-phase current with secondary two-wire system, single-phase current with secondary three-wire system, three-phase current with secondary three-wire system, three-phase current with secondary four-wire system, that is, a fourth or intermediate conductor.

For all of these, complete calculations have been presented, their cost computed and comparisons made. In favor of the single-phase three-wire system was the possibility of supplying greater distances with the secondary circuits and utilize the cross-section of copper to the best advantage, without exceeding the permissible drop. Against it we find the greater complexity in the transformer pits as well as at the house connections and especially in the installation, the difficulty of evenly distributing the load over the two branches without causing a difference of pressure, and finally the greater alternating pressure of about 240 volts, led into the houses.

	For long circuits where the drop in pressure is the dominant feature.		For short circuits, where the current density per sq. mm. is the dominant feature	
	Cross-Section.		Cross-Section.	
	In sq. mm.	In p.c.	In sq. mm.	In p.c.
Primary Circuits.				
Single-phase alt. current :	2 × 200	100	2 × 200	100
Three- " " " ..	3 × 100	75	3 × 120	90
Secondary Circuits.				
Single-phase alt. current :				
(*a*) With two conductors .	2 × 100	100	2 × 100	100
(*b*) " three " ..	2 × 25 + 17.5	33	2 × 50 + 35	67
Three-phase alt. current :				
(*a*) With three conductors	3 × 50	75	3 × 60	90
(*b*) " four " ..	3 × 16.7 + 10	30	3 × 35 + 20	61

The copper cross-section, however, is not the only determining factor in deciding on the cost of the system. There are also the in-

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creased cost of insulation of the several conductors, the extra cost of connecting parts, the transformers, etc. Then one must consider the smaller cost of the three-phase machine compared with a single-phase machine, and the reduction of fuel expenses due to the fact that the former is about 1 per cent. more efficient than the latter.

Exclusive of this fact the relative costs of the four systems of distribution are as follows:

(*a*) Single-phase alt. current, two wires, $497,504.
(*b*) Single-phase alt. current (sec. three wires), $504,353.
(*c*) Three-phase alt. current, three wires, $499,289.
(*d*) Three-phase alt. current (sec. four wires), $500,259. which shows that from a financial standpoint no one system has much of an advantage over any other.

It must be kept in mind, however, that the distributing circuits in the case of systems (*b*) and (*d*) on long stretches of the system have twice the capacity and the secondary circuits of system (*c*) about 20 per cent. greater capacity than the secondary circuits of the single-phase system, while the capacity of the primary conductors is the same for each.

When it finally had to be decided as to whether the single-phase or three-phase current should be used at Warsaw many things had to be considered. It cannot be denied that the single-phase motor has the disadvantage of starting only at light loads, the polyphase motor on the other hand has great torque at the start, is somewhat smaller and less expensive and is about 1 to 2 per cent. more efficient.

On the other hand, the single-phase motor where used to a very large extent, as at Frankfort a Ma., has not been so great a disappointment as might be expected, in view of the above facts. That it starts with difficulty causes annoyance in but few special applications, mostly in elevator work, and this can be overcome by mechanical devices.

The polyphase current, again, possesses numerous complexities and disadvantages when used on a distributing system of a large city, the centre of gravity of whose demand for electrical energy is not in its use for power but for lighting; starting from the machine there are always three wires, and therefore three poles, which increases the cost of switches and other apparatus on the switchboard, the bus bars, etc., as well as its connections and those in the transformer pits about 50 per cent. and adds to the complication.

The installations must be uniformly distributed over the three branches and in a large system it is possible only to regulate the total pressure and not the pressure on the several branches.

For the operation of the street cars the polyphase current (three-phase) would possess certain advantages if the question of direct operation by means of a three-phase current could be considered. But this is still an open question, and it seems doubtful whether overhead operation with three-phase currents is practicable, as the objections raised against the simple overhead system in use to-day would then be largely increased.

In case it is desired to transform the alternating current into direct and then feed the road by means of overhead or underground conductors, the two systems are on about an equal basis, in both cases rotary converters having to be used. The same is true for the charging of accumulators.

Mr. Lindley finally concludes to recommend the single-phase alternating current system and has worked out his specifications accordingly.

A second problem which presents itself is whether the current should be distributed among the consumers by means of single transformers or a secondary network. In the first case the transformers would be placed in or on the houses; in the latter case, excepting for large consumers, theaters, hotels, factories, etc., large transformers (group transformers) would be installed on public territory and the energy thus transformed to a low pressure be delivered to the consumers.

The first plan would effect a saving of the secondary network but presents numerous disadvantages.

There will be a large number of transformers, the types will be small, and for the same capacity considerably more expensive than large transformers; they must be sufficiently large to be able to meet the greatest demand of the consumer, and as this is generally an unknown quantity, they are usually chosen much larger than is really necessary. The total transformer capacity then would be much in excess of the actual consumption of energy by the city. Above all, the constant iron loss in the transformers is a strong argument against the use of single transformers.

The low efficiency of an alternating current station can be largely traced to the loss occasioned by the no-load consumption of transformers. The smaller the transformers, the greater this loss, and the greater the total number of transformers installed the greater of course will be the total loss. That system then offers the greatest advantages which employs the largest transformers and in which the total transformer capacity is a minimum.

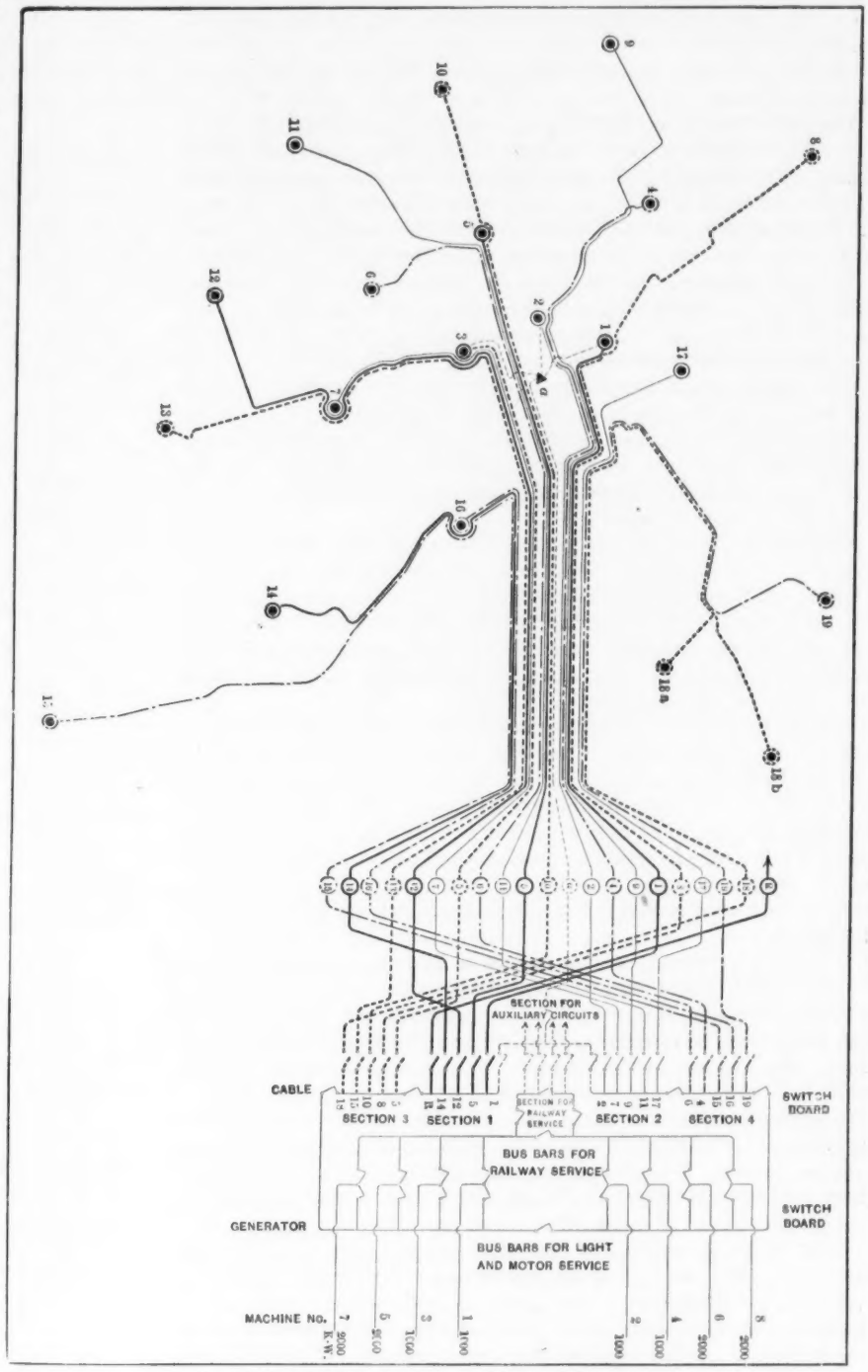


FIG. 5.—SINGLE-POLE DIAGRAM OF DISTRIBUTING SYSTEM.

The cost of a secondary network with a capacity of 70,400 incandescent lamps is $497,504, of which $122,624 go for the secondary circuit and $118,382 go for transformers and their housing.

To the numerous disadvantages cited against the single transformer plan should be added the fact that the high tension current enters every consumer's home, the inaccessibility of these high tension wires to the employees of the company at night, and the necessity to make a

large number of high-tension connections instead of low tension ones.

For these reasons the employment of a secondary network is recommended and transformers included in the public circuits and connected together in multiple. Such a system would consist of four main parts:

(1) The main feeders which carry the energy from the central station to the city's main feeding points, and there pass it over to the primary circuits.

(2) The primary network, which starts at the various feeding points, distributing the energy over the various districts and supplying it to the transformers.

(3) The transformers which transform the high tension into low tension currents.

(4) The secondary network which delivers the low tension current to the consumers.

The main feeders are made as short as possible and drawn wherever it is expedient through the same ducts. Their cross-section for a drop of pressure of 2 per cent. = 80 volts using a concentric cable of two conductors is .31 sq. in. With but two exceptions this section (2×200 sq. mm.) is very convenient and the copper cross-section so large that the cost of the cable and insulation is relatively small.

With the pressure, the drop and the distances in use at Warsaw each feeder is capable of transmitting from 500 to 1200-kw or supplying 9000 to 22,000 16-cp incandescent lamps. It is not profitable to combine greater capacity into one cable.

The subdivision of the supply districts has been carefully worked out in order to effect the most favorable distribution. The territory is divided into three zones, each with a different distance from the station, and have been so chosen according to their size that the capacity of the main feeders is adequate for the demand for current expected in the near future.

Care has also been taken to locate the supply districts in such a way that the most important consumers (the castle, City Hall, bank, theater, etc.), are situated at the border line between two or more supply districts so that they can be supplied equally favorably from any one of these districts. Care had also to be taken to separate the network supplying the frequently flooded portion of the city from the network of the upper city.

The primary wires all have a cross-section of $2 \times .054$ sq. in., so that six distributing wires of the primary network correspond to the cross-section of one main feeder, and the extent of the territory and the location of the main feeding points have been so chosen that the energy can be delivered to the transformers with no greater loss than ½ or 1 per cent. In selecting main feeding points the configuration of the streets was also taken into account, and such radially running streets were chosen which allowed the shortest possible length for conductors.

The "short" feeders supply the main feeding points of the first zone in which exists the greatest demand for current. Each feeder has the maximum capacity of 1200-kw, and the radius, up to which the energy may be distributed from the main feeding point, is a minimum, about ¼-mile, all of which is calculated to best serve this district with its large consumption and small area.

The "mean length" feeders supply the feeding points of the second zone, and have a length of from 1 to 1½ miles and a capacity of from 1140 to 800-kw. The load on the distributing circuits is a fair one; they are therefore of greater length, about 1600 to 2000 feet, and are designed to meet the mean demand in a fair-sized district.

The "long" feeders supply the outer zone and vary in length from 1½ to 2½ miles and have a capacity of from 780 to 500-kw. Starting from these feeding points the load on the primary circuits is a minimum, the territory over which these are distributed a maximum, the mean lengths of the primary distributing circuits of from 2000 to 3000 yards and the whole calculated to serve a large territory with relatively small demand for current.

AUXILIARY AND EQUALIZING CIRCUITS.

Although each individual feeding point is fed directly by the main feeders, provision has been made for supplying each of them from some other source in case of a breakdown on the main feeder system.

This is done in a manner similar to that employed in a water supply system by making use of neighboring lines in case of necessity. Such lines are shown in the diagram Fig. 5.

With the calculated drop of 2 per cent. on the feeders an overload of 50 per cent. is permissible on those feeders which are not already fully loaded, that is, on all but five feeders. It is therefore sufficiently safe if a main feeding point, in case of necessity, can be supplied from two other main feeding points. In laying out these various circuits the ring system has again been adopted, as seen in Fig. 5, but on account of their small distance from the station, three of the feeding points are supplied by a reserve cable, *a*, which has a cross-section of $2 \times .31$ sq. in., to which the three points are connected by cables of the same cross-section. This arrangement has been deemed advisable on account of the great importance of those three feeding points.

Besides the laying of these auxiliary conductors, other circuits have been interwoven with the network of feeders which perform the function of equalizers, i. e., equalize the network in case several districts become loaded in excess of others. The ring circuits in the two zones perform this function themselves, but it is of great importance to effect an equalization in a radial direction from the central station during such time when there is a maximum consumption.

PRIMARY CIRCUITS.

The primary wires which conduct the electrical energy from the main feeding points to the various transformers have a cross-section of $2 \times .054$ sq. in. In order to solve the distributing problem on a small scale in this network as was done on a larger scale in the case of the main feeders, auxiliary and equalizer circuits are interlinked with the primary conductors, which also have a cross-section of $2 \times .054$ sq. in. In this manner each transformer is fed by at least two, generally by more than two circuits of the primary network, and its supply is not interrupted by the cutting out of one or the other circuit. In order to further extend this inter-connection it is proposed to operate the primary wires in the various districts in more or less conjunction. It might be found advantageous, however, to separate the primary wires in one district from those in the adjoining one and to operate each one independently; for certain purposes this plan has advantages.

To accomplish this and at the same time to insure the equalization of the primary conductors at the high pressure at which such equalization can naturally be effected much more completely than in the secondary conductors, was one of the principal problems to be solved in connection with the equalizing circuits between main feeding points. With a comparatively small number of connecting circuits they enable the operation with connected feeding points and insure the equalizing without the necessary connections at several hundred points between the primary conductors. The connection can therefore be effected, if required, by quickly switching in at a few points or the operation may be made automatic by the blowing of several fuses.

Mean Spherical Candle-Power.

By Prof. Wilbur M. Stine.

The terms *mean spherical* and *mean hemispherical candle-power* have proven distasteful to those who wish to deal alone in conceptions and formulas which correspond to things which actually exist. But these terms have persisted and proven very useful working conceptions and deserve to receive sufficient attention to be thoroughly understood.

Very frequently in connection with the direct-current open-arc the data given under these conceptions have been calculated from two mean values—the mean horizontal and the maximum candle-power, or the candle-power at an angle of some 45 degrees to the horizontal. The equation stands—

$$MSCP = \frac{HCP}{2} + \frac{MCP}{4} \qquad (1)$$

This method would obviate a tedious exploration of the light field about an arc, but, unfortunately, being practically an empirical one, it is neither scientific nor does it carry with it confidence in the results obtained.

It is proposed here to examine the theory of these conceptions, and seek for working methods to enable these quantities to be calculated readily.

THE THEORY OF THE QUANTITIES.

This will be considered from a geometrical standpoint. In Fig. 2 *O* is the centre of the polar co-ordinates along which certain radial distances are platted, while the curve joining their extremities has a contour somewhat resembling the distribution of the luminous intensity about an alternating current arc. The problem is to find the mean radial distribution about the centre *O*.

Considering the case shown in Fig. 1, wherein the curve is a

circle *OMN*, whose periphery passes through *O* tangent to the vertical co-ordinate *TOS*; the polar equation to such a curve is—

$$r = 2a \cos\theta \qquad (2)$$

$a = \frac{1}{2} O P$ being the constant radius of the curve and r the variable

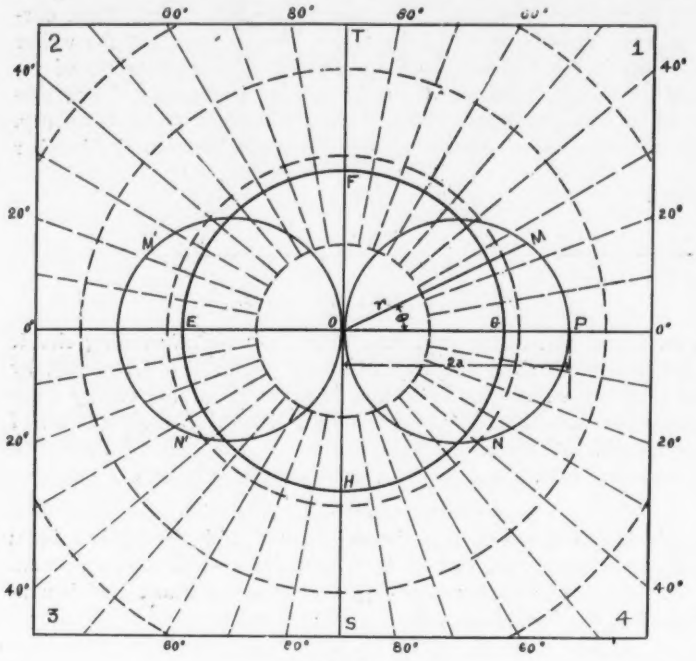


FIG. I.

distance along the polar co-ordinates from *O* to the periphery of the circle *OMN*.

The area included by the circular curve is found by the double integration of

$$A = \text{area circle} = \int_0^{\frac{\pi}{2}} \int_0^{2a \cos\theta} r \, dr \, d\theta \qquad (3)$$

It is to be observed that the law of the variation of the distance from the centre *O* to the curve is known, and this distance is a continuous function of the inclination to the horizontal co-ordinate. Similarly, in all cases in which the radial distance is known to be a continuous function of the inclination the area included by the curve may be found.

Further, it is supposed that the circle is a section through a figure of revolution about the vertical co-ordinate *TOS* as an axis; and it is desired to find the dimensions of an equivalent sphere whose radius

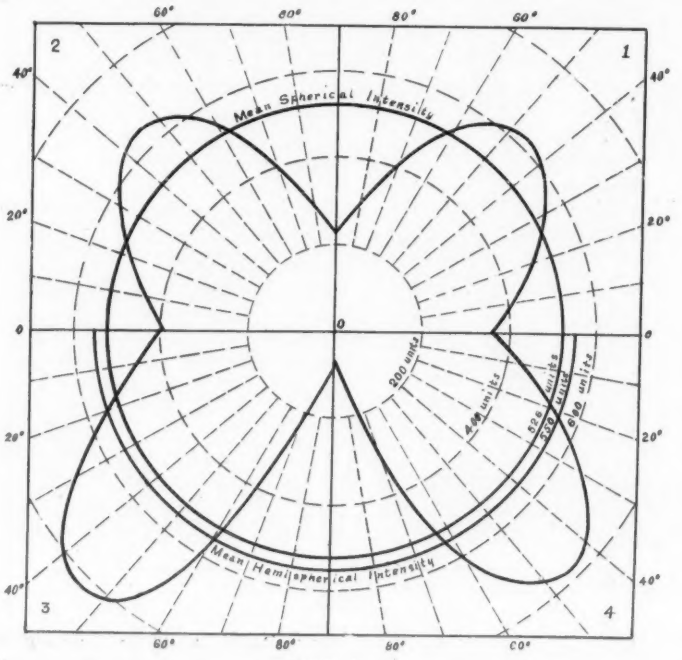


FIG. 2.

shall be the mean radius of the figure of revolution. The section of the figure of revolution taken through the axis *TOS* would show two equal circles *OMN* and *O M' N'*, having each the area *A* as found by the above equation.

The section through the equivalent sphere having the centre *O* in common with the figure of revolution will be a circle whose area is $2A$, the area of the section of the figure of revolution. The radius r' of the mean sphere is then readily found, and is

$$r' = \sqrt{\frac{2A}{\pi}} \qquad (4)$$

In the figure the area of the circle *EFGH* is taken as double the area of *OMN*, and thus represents a prime section through the mean sphere, and *EO* is thus the mean spherical radius of the equivalent of the figure of revolution.

When the equation to the curve cannot be stated, or rather the radial distance is not a continuous function of the inclination, the area cannot be integrated by purely mathematical processes, and recourse must be had to mechanical integration. This may be done either by a planimeter or by graphical construction.

The four loops in Fig. 2 are such an instance, and represent a distribution which is different in each of the four quadrants. In this figure, the area bounded by the curved contour and the rectangular axes, is found for each quadrant, and the sum of these areas is equated to the prime section of the equivalent mean sphere, the radius of which is then found by the equation—

$$r' = \sqrt{\frac{\Sigma A}{\pi}} \qquad (5)$$

THE PRACTICE OF THE MEAN SPHERICAL QUANTITIES.

It is evident that the ideal light source which has been discussed—a small point, does not apply to all sources met with in practice. With the incandescent lamp, the light source is a looped, luminous filament, and the base of the lamps prevents the emission of light in that direction. With the arc lamp, the distribution of light varies

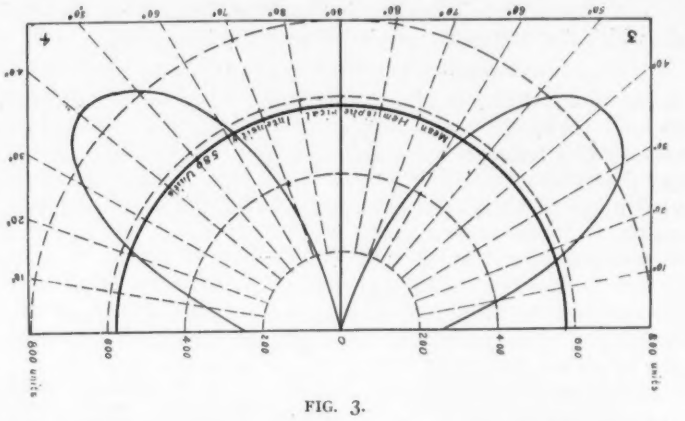


FIG. 3.

widely with the type, and in all cases shows a marked irregularity. Similar conditions exist with gas flames and incandescent gas mantles. Also the distribution of the emitted light is again profoundly varied by the use of reflectors and enclosing chambers and globes.

These irregularities render it difficult to specify the illuminating power of any of these light sources in general terms; and the comparison of one light source with another is no less difficult and ambiguous.

The light distribution about an incandescent filament is a function of its cross section and the form of the loop. To express its illuminating power with accuracy, the radial direction along which it is specified must be noted, whether it is horizontal, vertical, or at a given angle of inclination to the horizontal plane through the filament; and the azimuth, too, must be given. Incandescent lamps having filaments of differing shapes can not be directly compared, for their light distribution is not similarly intense along a specified vector or radius.

The light distribution about the open arc of a continuous current lamp is notably deformed from a spherical one; nor is the distribution constant, for it varies from time to time, as the carbon tips burn to a new shape. It also varies with the size and quality of the carbons burned. So irregular is the distribution that the statement of the illuminating power of a given arc is without significance unless it is stated along a specified vector. The problem increases in complexity and uncertainty as the arc lamp considered is of the alternating current type, or is an enclosed one.

The practical applications of these varied light sources as well as their scientific uses render a system imperative for the specification of illuminating power and the comparison of illuminating intensities.

In Fig. 2 is shown a distribution of luminous intensity about an alternating current arc; and while the distribution is not strictly a figure of revolution, or symmetrical about any axis, the curve shown is the distribution on a vertical plane through the arc centre, and will be considered as an average of all similar plane distributions. The maximum intensity here exceeds 800 units and the minimum is less than 400. The area of the curves in the four quadrants was found to be, using a planimeter—

Quadrant 1..... 4.8 square inches.
Quadrant 2..... 5.0 square inches.
Quadrant 3..... 6.1 square inches.
Quadrant 4..... 5.8 square inches.

Yielding a total area included by the curved contour of 21.7 square inches. This area was equated to the area of a prime section of an equivalent sphere, whose radius was found to be 2.63 inches. This circle being now considered as a section of a figure of revolution, it defines the equivalent mean sphere distribution of the light; and the radius of this equivalent sphere is 2.63 inches. Referring this dimension to the scale on which the curve was platted, the mean spherical intensity is found to be 526 candles.

The meaning of this quantity is obvious—if the flux of light across the actual surface about the arc *O* of which the curve is a plane section, was uniformly distributed over an equivalent spherical surface, this surface would be one of mean value for the flux, and the radial intensity would be the mean spherical intensity desired.

In a similar manner, if the light flux indicated by the curve in any one quadrant, such as 1, 2, 3 or 4, is alone considered, the area between the contour and the axes may be taken and equated to the area of an equivalent circle, and the radius of the circle will be that from which the equivalent mean spherical intensity of this quantity of light from the arc *O* can be found. Or any two quadrants may be considered at pleasure, and the mean spherical intensity of the quantity of light which they represent may be accordingly determined.

THE MEAN HEMISPHERICAL INTENSITY.

A second aspect may be given to the method: Suppose that the light flux indicated by the curves in quadrants 3 and 4, Fig. 2, be considered only with reference to the light distribution below the horizontal plane through the arc *O*. The sum of the areas between the curves and the axes of the quadrants 3 and 4 is equated to an equivalent semi-circular area, and the radius is found as before. By means of this radius the mean hemispherical distribution is defined, which in the case platted amounts to 550 candles. This lower mean hemispherical intensity is greater than the mean spherical intensity taking the four quadrants into account, since the flux of light over the space below the horizontal plane is in excess of that above it, as is shown by the curves.

A better defined case is shown in Fig. 3; the light distribution was platted only over the section below the horizontal plane through the arc *O*. The areas included between the curves and the horizontal axes are—

Quadrant 3..... 6.55 square inches.
Quadrant 4..... 6.65 square inches.

Their combined area of 13.2 square inches is equivalent to the area of a semi-circle of 2.9 inches radius, which scaled, defines the mean hemispherical intensity to be 580 candles.

In the general consideration of continuous current arcs, the mean hemispherical intensity rather than the mean spherical is of value, for the illumination is utilized in the horizontal plane or below it.

It is obvious, however, that the mean spherical and hemispherical values have but little practical bearing on questions of illumination in general. For the specific illumination of an object or for illumination in any specific direction, the actual intensity in such direction is the important quantity to be determined; but for the complete comparison of one light source with another, and for ascertaining the efficiency of any light source, the mean spherical value must be considered.

The Cuban Cable Monopoly.

The Boards of Trade in various Western cities are taking steps to break the cable monopoly to Cuba now enjoyed by the Western Union Telegraph Company. The movement was started by the Kansas City Board of Trade, and other bodies of like character are agitating the matter. The Kansas City organization called the attention of the Secretary of War to the fact that they, with other Western cities, were being discriminated against in the matter of cable tariffs.

The Drop in Alternating-Current Wires.

BY CECIL P. POOLE.

Much has been said and printed on the subject of the increase of drop in alternating-current wires due to the inductance of the current, and the basis of all of the tables, curves, etc., that the writer has seen is the impedance of the circuit. The only tables of reactances of which the writer has knowledge is the limited one prepared by Mr. Mershon,* which applies only to 60 cycles frequency. For the purpose of computing the difference between the bus-bar

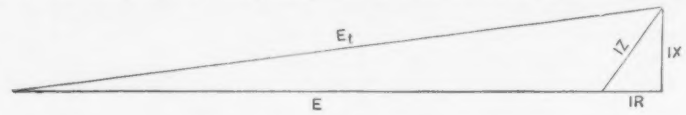


FIG. 1.

e. m. f. and that at the load (the drop over the intervening circuit wires and translating devices) with any degree of convenience, by far the simplest method is to add together all of the energy components of each element of the complete circuit, similarly add all of the inductive components, and find the vector sum of these two arithmetical sum. In short, to use the general formula:

$$Et = \sqrt{(EV)^2 + (EIX)^2}$$

in which *Et* is the e. m. f. at the switchboard, *V* is the *IR* drop in an element of the circuit, and *IX* is the reactive e. m. f. of one element.

In the case of a feeder supplying a transformer whose load is non-inductive, the formula may be expanded to read

$$Et = \sqrt{(Ep + IR)^2 + (Eq + IX)^2}$$

E being the impressed e. m. f. at the transformer; *p* its power factor; *q* its inductance factor (the sine of that angle whose cosine = *p*); *R*,

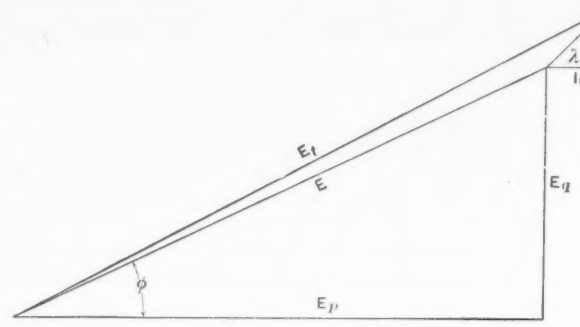


FIG. 2.

the resistance of the line wires; *X*, their reactance and *I*, the current. The drop in volts over such a line will be obviously

$$\sqrt{(Ep + IR)^2 + (Eq + IX)^2} - E = D$$

and the drop in per cent. of the e. m. f. delivered to the transformer will be

$$\sqrt{\frac{(Ep + IR)^2 + Eq + IX}{E^2\ 10^{-4}}} - 100 = D\%.$$

These formulas look forbidding, but in reality they are perfectly convenient of application with the assistance of a table of squares

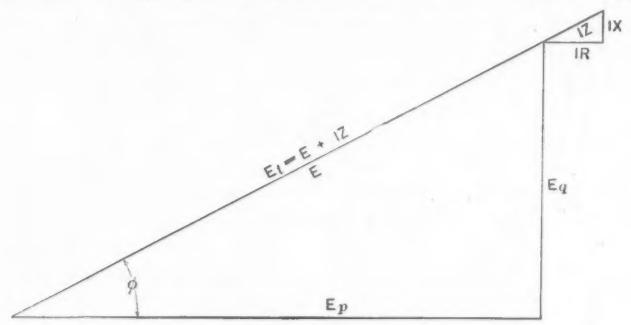


FIG. 3.

and roots, and one of resistances and reactances. Tables of squares and resistances are plentiful; why has not some of the energy bestowed upon impedances been saved by stopping at reactance and making a table of values for various conditions? And where do line impedance, impedance factors, etc., come in? There really is not the least need for them. A reactance table can be easily prepared

from a table of impedance values, of course, using the formula:

$$X = \sqrt{Z^2 - R^2}.$$

In this connection, it seems rather odd to the writer that most persons who should know better labor under the misapprehension that the drop in line wires is directly proportional to the line impedance; that one only needs to multiply the IR drop by a line-impedance factor in order to find the drop in volts. An inspection of Figs. 1, 2 and 3 will show the falsity of such a proposition. Fig. 1 is a vector dia-

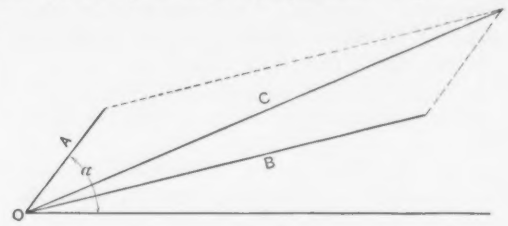


FIG. 4.

gram of the differences of potential of a pair of leads and a non-inductive load; Fig. 2 is a similar diagram for a pair of leads and a motor, and Fig. 3 is a diagram of the same character in which the motor and the line wires have identical "power factors," or, more accurately stated, when the ratio $\frac{Z}{R}$ is equivalent to p.

It is obvious that only in the last case does the drop bear a simple relation to the line impedance; here it is equal to IZ. Not only is this the only case wherein this relation holds, but the ratio of $IZ : D$ changes with (1) every change in the ratio of $Ep : IR$; (2) every change in the ratio $Eq : IX$; (3) every change in the ratio of $p : q$, and (4) every change in the ratio of $R : X$, unless *all* of these ratios simultaneously and proportionately change. In short, every change in the ratio between two angles, λ and ϕ changes the ratio between the line impedance and the actual drop, and what is worse, neither the drop nor the ratio of $IZ : D$ is a straight line function of any interrelation of the angles.

It is true that the line impedance may be made a factor in the computation of the drop, by using the formula

$$\sqrt{E^2 + I^2 Z^2 + 2 E I Z \cos \lambda - \phi} - E = D,$$

but this is not a thing to be contemplated joyously. The angle λ must be fished out with the help of equation

$$\text{secant } \lambda = \frac{Z}{R} = \text{line-impedance factor};$$

and it usually develops to be some such attractive combination as 24° 36′ 27½″ (as a matter of fact this is almost exactly the angle for No. 4 wires, 12 inches apart, at 133 cycles). Then the cosine of the difference between the lag angle of the motor and the ornamental array just mentioned must be fished out. Then, if one has not forgotten at just what part of the performance he has arrived, the remainder of the solution is comparatively convenient. Of course, none of it is mathematically difficult.

The above formula is derived from the well-known geometrical equation of the parallelogram of forces, to wit:

$$C = \sqrt{b^2 + a^2 + 2 a a \lambda \cos a}$$

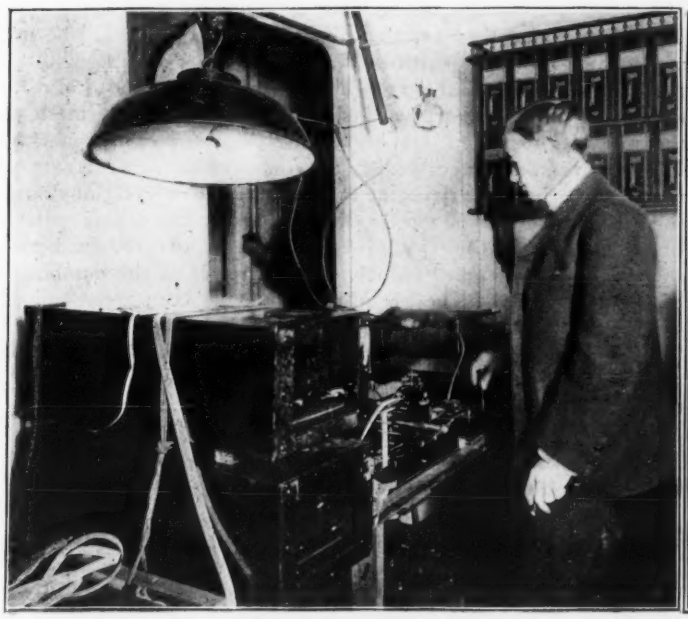
as applied to the vector diagram, Fig. 4. The relations between this and Fig. 2 are as follows:

a corresponds to IZ;
b corresponds to E;
c corresponds to Et;
α corresponds to $(\lambda - \phi)$ or $(\phi - \lambda)$ according to which of the angles, λ and ϕ, is the larger.

In a case, like that of Fig. 3, where the two angles are identical, their difference is zero, so that the factor cos $(\lambda - \phi)$ in the right hand term under the vinculum becomes unity, leaving the whole expression under the vinculum $E^2 + (IZ)^2 + 2EIZ$, which reduces to $(E + IZ)^2$, the square root of which, of course, is $E + IZ$; so that for such a case $D = E + IZ - E = IZ$, as an inspection of the diagram shows without mathematical proof. As cases in which the two angles coincide form a woful minority in actual practice, the writer confesses his inability to discover any advantage derivable from line impedance tables or charts or factors.

The Marconi Experiments for the U. S. Navy.

Few events in the department of electrical application have excited more interest of late than the work done by Mr. W. Marconi in reporting the international yacht races with his system of wireless telegraphy for the *New York Herald*. The successful results were reported and illustrated at the time in these pages. The work was new in this country so far as the distances were concerned, and the utilization of the system at sea, but abroad considerable work had already been done also by the navies of England, France and Italy, and when it was seen—as we saw for ourselves—that as many as some 60 odd messages could be sent correctly within three or four hours, over distances varying up to 15 miles, it was natural that the American Navy should take up the matter, and try the apparatus for itself; although Mr. Marconi stated to us on his arrival that in view of the short range of the yacht races he had not brought his most sensitive cohering apparatus with him, as used in the British Navy. While the races were on—and they certainly lasted long enough to try men's inventions as well as their souls pretty thoroughly—the U. S. Navy had some of its expert officers watching Mr. Marconi's work, and after the races, as already noted in these pages, a commission comprising Lieut.-Commander J. T. Newton, and Lieuts. J. B. Blish and F. G. Hill were appointed to make a series of experiments in the waters off New York. Our last issue gave some data as to their work.



FIGS. 2 AND 3.—TRANSMITTING AND RECEIVING WIRELESS MESSAGES ON U. S. WARSHIPS.

We now print several illustrations (Figs. 1, 2 and 3) relating to the recent experiments with Marconi's system for naval service.

Fig. 2 shows the transmitting apparatus as installed aboard the New York, and Fig. 3, the receiving apparatus on board the Massachusetts. In Fig. 2 the operator is in the act of transmitting a message, as is plainly indicated in the photograph by the spark passing between the knobs of the induction coil.

The results obtained from the Marconi experiments on the naval vessels were to some extent unsatisfactory. The first long-distance tests was between the New York, at anchor opposite Hoboken, and the Massachusetts, under way. The signals sent by the New York were received aboard the Massachusetts continuously out to the Sandy Hook Lightship, but those from the Massachusetts to the New York were not legible aboard the latter vessel beyond a distance of nine miles.

Signals were also transmitted from one or the other vessels to a station at Navesink. The messages from the latter were legibly recorded aboard the New York at a distance of 36 miles, but the receiving apparatus aboard the Massachusetts ceased to operate satisfactorily beyond a distance of 17 miles. A test to send simultaneously, without interference, messages from two points was a failure. In each case the transmitting signals intermingled and produced an illegible receiving record.

It is claimed, as already noted, by those who were in charge of the Marconi interests that the apparatus used was not of the proper kind for the class of experiments undertaken, as it was selected and brought to this country for the sole purpose of reporting the yacht races. Mr. Marconi informed us himself that in the British Navy his distances ran over 80 miles and that he could do better with his latest appliance, besides "focusing" or syntonizing the

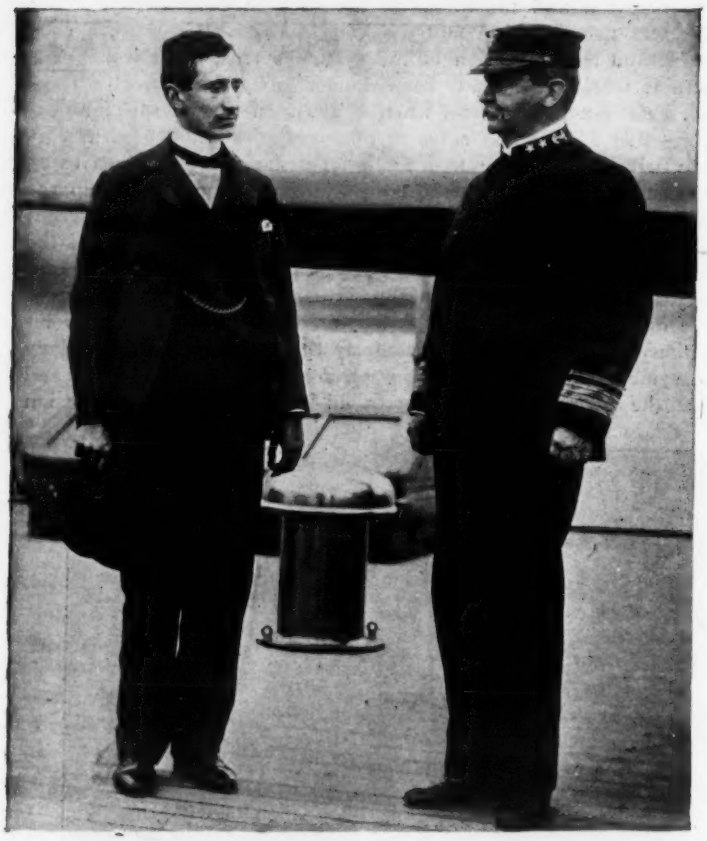


FIG. 1.—MARCONI AND ADMIRAL FARQUHAR.

messages and preventing interference. As it was, the apparatus appeared to be far more efficient than any that had hitherto been set in operation in this country.

It was reported that one of the means to have been tried for cutting off interference was the use of a shield of wire cloth, protecting the vertical wire; but apparently the very bad weather prevented this test. The arrangements for carrying up the vertical wires were the same in all cases and are now familiar. In no case does the enormous mass of iron and steel that constitutes the modern warship appear to have had the slightest effect in cutting down the efficiency of transmission.

As a sequel to this work, the American Institute of Electrical Engineers will devote its meeting on November 22 to the subject of wireless telegraphy, Prof. R. Fessenden leading off in New York, and Mr. A. V. Abbott in Chicago.

Argument For the Fundamental Tesla Polyphase Patents.

During the past few weeks, argument has been heard by the U. S. Circuit Court for the District of Connecticut, at New Haven, in the case of the Westinghouse Electric & Manufacturing Company against the New England Granite Company, et al., for infringement of the Tesla polyphase patents, Nos. 381,968, 382,279 and 382,280, the first of these dating back to May 1, 1888. The defendant concern has been using a polyphase plant alleged to infringe these patents. For plaintiffs the case was argued by Messrs. F. H. Betts, L. E. Curtis, and T. B. Kerr, and for the defendant by Messrs. C. E. Mitchell and H. B. Brownell. The motor sued on is a Cushman supplied with current from a General Electric three-phase generator.

In his argument, Mr. Betts asserted that with the publication of Mr. Tesla of his invention before the American Institute of Electrical Engineers in May, 1888, and with the simultaneous grant of his patents, "a new thought, a new era of construction, and even a new department of electrical terminology" came into the world, and that these facts were at once admiringly conceded by electrical engineers everywhere. The expression of contemporaneous opinion as to the character of a step in an art has always been deemed by the courts, in patent cases, as of great significance (see the Telephone Case, 126 U. S., p. 1; New Process Fermentation Co. vs. Maus, 122 U. S., p. 413; Electric Accumulator Co. vs. Julien Co., 38 F. R., p. 132). Mr. Tesla had found existing systems of power generation and transmission inadequate for their work. Direct current was not available in large quantities for long distances and was cumbered by the use of a commutator. Single-phase alternating current had failed because of the troubles due to obtaining synchronism between generator and motor, and the art was virtually at a standstill, except in regard to the use of current in small areas or small quantities. This then, was the state of the art as Tesla found it. Alternating currents were the only long distance power currents anywhere generated. But alternating currents could not be used as such successfully, for transmission of power, or, in other words, in "motors," because the alternations for the effective transmission of power were too fast. The motor could not keep up with them. It might be brought up to synchronous speed and would continue to run as long as such synchronism was substantially maintained. If a load was put on the machine which impaired synchronism the motor stopped. Mr. Tesla set himself to work to reconcile contradictions and to overcome difficulties which had blocked the way of the use of alternating currents in their initial condition. In doing this he turned the difficulties into means of success.

His new conception was that alternating currents could be made a source of power, notwithstanding the rapidity of alternation, or rather by reason of the rapidity of their alteration of direction (for, other things being equal and within practical limits, the higher the rate of alternation, the higher the efficiency of the machine). He perceived that by combining two or more of such currents, displaced in period of arriving at each point in their cycle of changes, the rising potential of one would accompany the falling potential of the other, and their joint effect would be to produce between them a "resultant pole" (which was the result of the combination of the magnetism of both), which would be constantly and progressively shifting its position around a circle, and which thereby produced a "whirling field." This met every difficulty by creating a continuous force in one circular direction, which tends continuously to drag the armature after the point of greatest attraction in the "whirling field," and thereby produces a source of power which becomes more effective the more rapidly it whirled; that is, the more rapid the alternations in direction.

The whirling field produces a condition in the motor which will always tend to start the armature, and will, in fact, start it, if the armature be of proper construction, and will cause the armature to run faster and faster to endeavor to catch up with the swiftly whirling pole. In this way "power" is generated. A practical alternating current motor (i. e., something that would move something else) was made. A motor capable of carrying large loads at high speeds was produced, the efficiency depending, so far as the "whirling" field was concerned, upon the rapidity of alternations in the generator, and the starting capacity and mutual attraction between such field and the armature, depending upon the particular construction of the armature. This, then, is the gist of the Tesla method and apparatus for transmitting power.

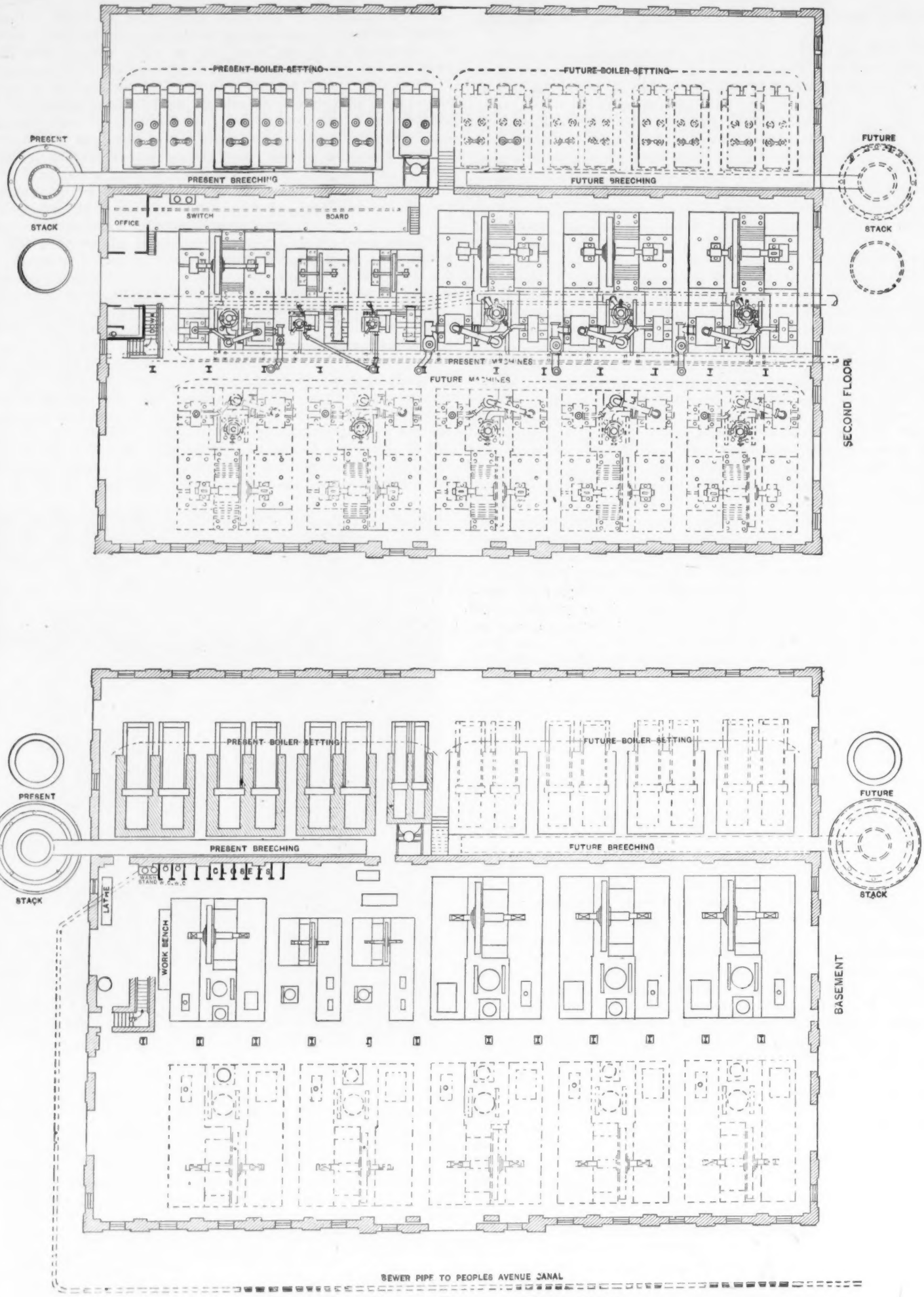


FIG. 7.—PLAN VIEWS OF ENGINE AND BOILER ROOMS.

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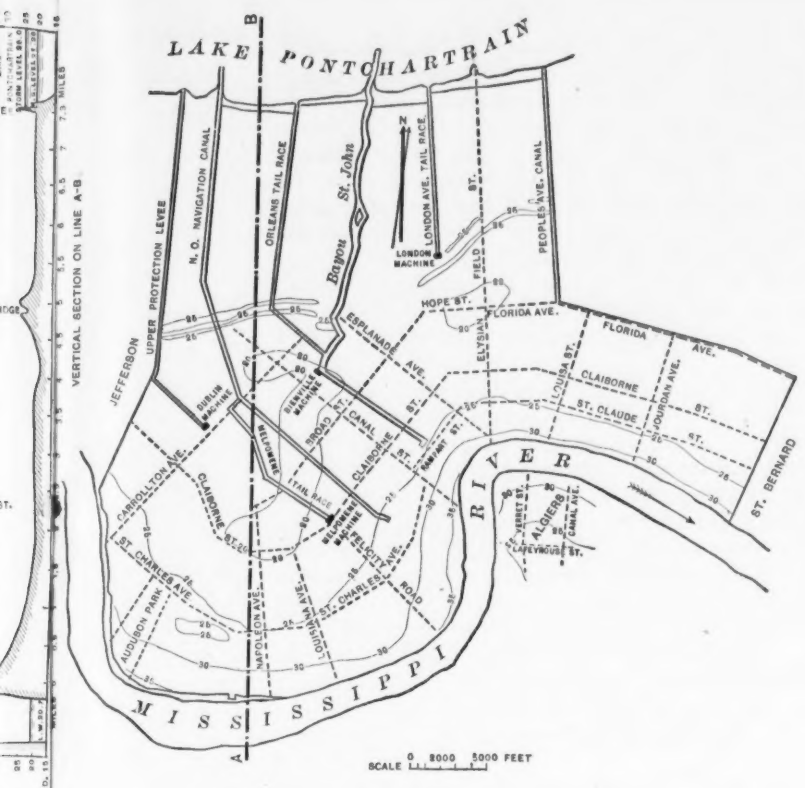

FIG. 9.—CAIRO DATUM CURVES.

SECTIONS, PLANS, ETC., OF NEW ORLEANS DRAINAGE PLANT.

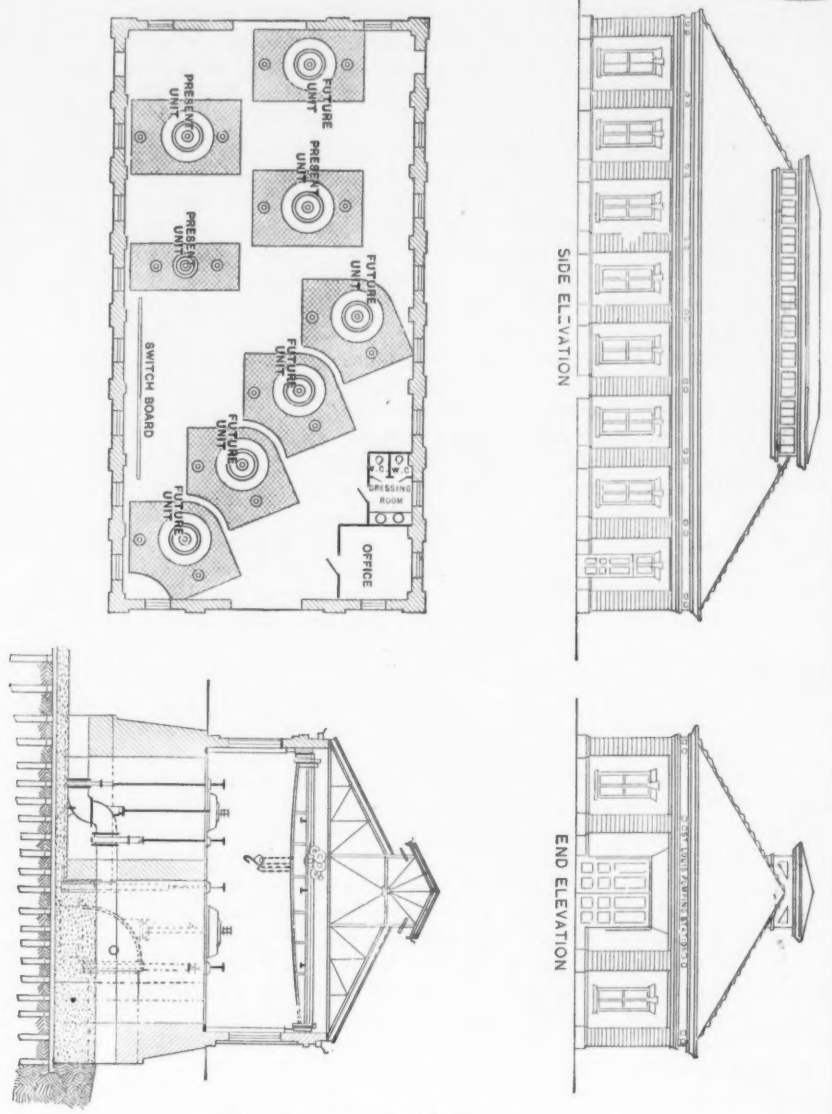

FIG. 10.—PUMPING STATION.

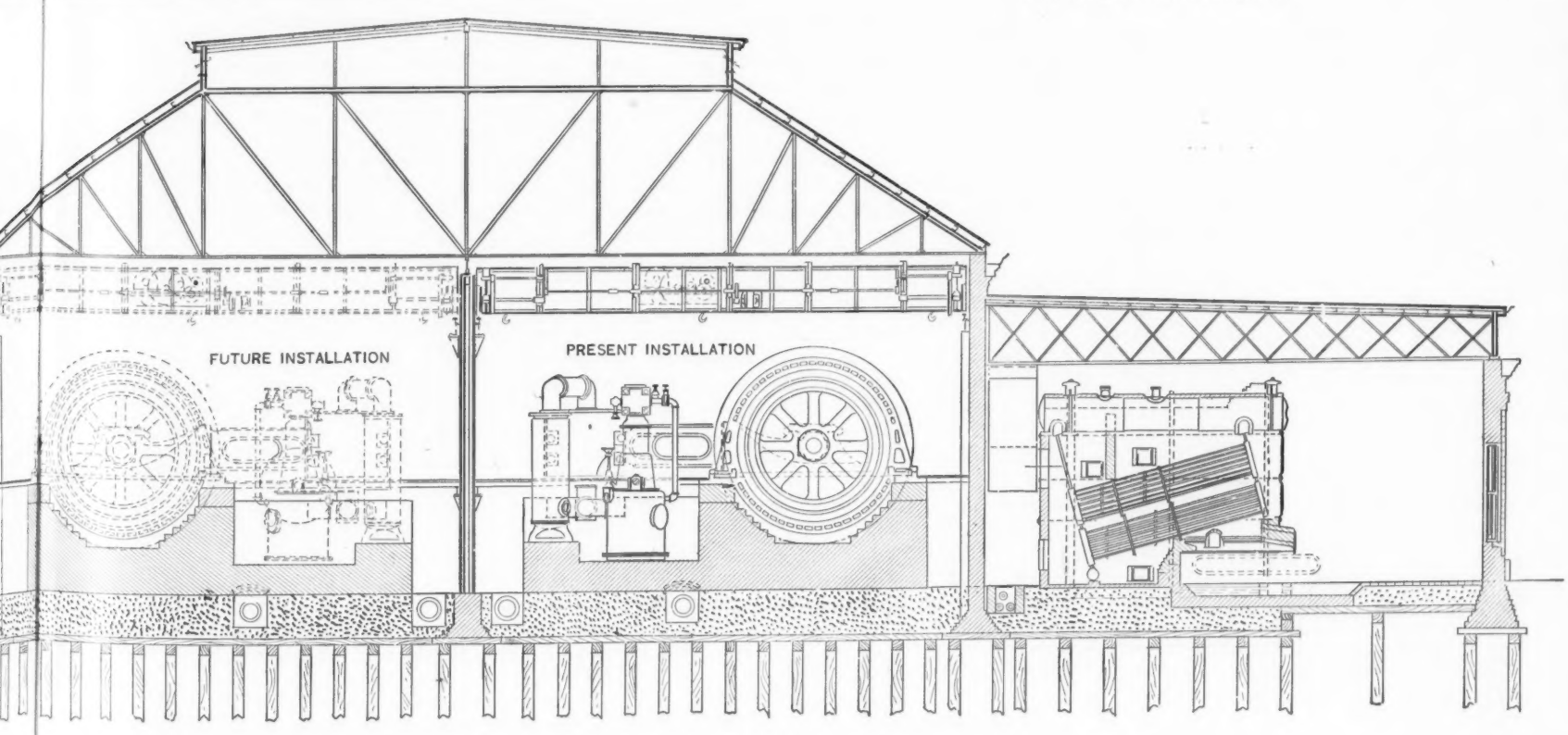

FIG. 8.—CROSS SECTION OF ENGINE AND BOILER ROOMS.

The "method" consists of the generation and utilization of two or more alternating currents of different periodicity to produce in a motor having corresponding circuits, a whirling field, or source of power. The "apparatus" consists, essentially, of a motor having a plurality of circuits, in which alternating currents of differing phase are produced, without mingling or interfering with each other, combined with a generator of alternating currents of differing phase, connected to the motor by transmission conductors of such a character as to preserve the independence and proper succession of phases, and thereby produce the whirling field. The method of operation just described is fully set forth in the Tesla Patent No. 382,280. The primary patent for the apparatus is No. 381,968.

But Mr. Tesla, having laid his foundation, said Mr. Betts, made other and supplementary inventions, and one of these is embodied in the third patent, No. 382,279, in which an armature of great capacity for developing a condition of structural attraction between it and the field is described. The gist of this is the construction of the motor with an armature (or moving member) wound with "closed coils." The effect of these closed coils is that the attraction between the moving armature and the field is increased by any lagging behind in speed of the armature with reference to the "whirling field" of force. There are subordinate claims in Patent No. 381,968 and No. 382,279, for improvements in the form of construction of the field magnet in a multiphase alternating current apparatus. These claims are founded upon the superiority of the "annular" or "ring" type of field magnet in the apparatus of the multiphase type.

Mr. Betts went on to point out that the utility of the invention, as such, was never contested, and deprecated the defendant's contention that it was merely an "invention on paper." Mr. Tesla built such motors and showed them, and his system had come largely into use. Moreover, attacks upon the degree of utility of machines made in exact accordance with the drawings of a patent have been so often characterized by the courts as futile that there should be an end of such defences. The Supreme Court of the United States in the Bell Telephone Case swept away a far more vigorous contention of the contestants, because based upon the fact that Prof. Bell had never in fact utilized the exact instrument of his patent for the successful transmission of a single articulate word (126 U. S., 1.). In Loom Co. vs. Higgins, 105 U. S., 586, the court said: "When the question is whether a thing can be done or not it is always easy to find persons ready to show how not to do it." Judge Coxe, in the Mergenthaler Case, 57 F. R., p. 502, satisfactorily disposed of all such defences, and in the latter case of Rynear Co. vs. Evans, 83, F. R., p. 697, he sarcastically remarked that a judicial experience of many years had convinced him "that when an expert undertakes to prove that his adversary's process or machine is a failure he always scored a success."

Mr. Betts then discussed four publications which were assumed by the defendant to anticipate Tesla. The first of these was by Mr. W. Bailey, in 1879, on a mode of producing Arago's rotation. But Bailey made not the faintest suggestion of the use of two "alternating" currents of differing phase generated by an alternating-current generator, and used to produce a shifting of the magnetic field in a motor. Bailey's paper describes no phenomenon except the ordinary one always present in every direct-circuit machine, of intermittently shifting the attractive poles by the reversal of a straight current by means of a commutator. Tesla does not claim, of course, to have been the first to produce a progressive shifting of the poles of a motor by any and all means. What he describes and claims is the method of progressively shifting such poles by combining two true alternating currents of differing phase. In his paper of May, 1888, he distinctly states this.

The next publication was that of Deprez in December, 1883, and later. But all that he demonstrated as a mere theoretical abstraction was that, if a machine were made in which the field magnet varied in position with reference to the brushes, the variation would be indicated by the needle of another machine. The needle of another machine would move so that whenever the angle between the brushes of the first machine moved, it would stop and indicate on a scale, attached to the second machine, the new angle which was subtended between the brushes and magnet. The only practical application of this thought was to indicate upon a ship's compass the position of the magnetic pole with reference to the course of the ship. It was said by the expert for the defendants that if the machine described by Deprez, which was constructed with a magnet and brushes capable of changing their angle with reference to each other, had been so used as to rotate the brushes continuously, the machine would have produced currents, not only differing in period of maximum and minimum potential, but also alternating in direction at proper intervals.

But certainly Deprez did not describe this, and had not the remotest idea of utilizing either the alternations of direction or the rapidity of such alternations, or the progressive and regular sequence of cyclic changes produced by continuous alternations. The only suggestion which Deprez makes is that the theorem of the parallelogram of forces can be employed to produce an indicator of position. The idea of utilizing that law, as exemplified in a two-phase alternating-current machine as a source of power, never dawned upon his mind. In fact, he pronounced alternating currents to be useless for power purposes, and in his famous Paris to Creil experiments resorted to direct current.

Next came the Siemens and Von Alteneck English patent of 1878, but Mr. Betts contended that all that could be asserted of the Siemens patent was that, in the case of a single one of the machines the position and connection of coils is such that the machine would initially generate two alternating currents of differing phase, but the inventors do not mention this fact. Nor if they had it, would such distinguished inventors have allowed such a useful invention to slumber for ten years in oblivion. Moreover, every machine described was equipped with commutators to straighten out the current.

The last defence in the shape of publication was Bradley's application of 1887, culminating in a patent of October, 1888. It was claimed that only the application could be considered, and that most assuredly was only a thing on paper. But the Bradley application, even if it were competent by itself, presents nothing of material importance. True, it describes a generator which is capable of producing not only direct currents—by means of a "commutator"—but also one or more alternating currents, and there is a general statement near the end of the specification, that "It is obvious that my machine may be used as a motor as well as a generator, and that it may when so used be fed or actuated either by continuous or alternating currents or both." But this is very far from a statement that two or more alternating currents, as initially produced in a generator, are deliberately and intentionally not to be "commutated" or straightened, but, on the contrary, are to be conducted by proper circuits, which preserve their initial independence of phase, and then, without "commutation" are to be utilized in corresponding circuits of the motor. True, Bradley claims in his original third claim an "alternating current dynamo-electric machine with windings to produce currents of differing phase." But Siemens had described such a machine in 1878, and Bradley does not claim, and nowhere even suggests, the use of such a machine as a motor by means of uncommutated currents of different phase. So, in his fourth claim, he claims an "alternating current dynamo-electric machine" having its armature wound with a closed coil, and utilized by means of complete contact rings, and such contact devices as are shown. But he fails to point out anywhere in his specification, or suggest in his claim, the combination of such a generator with such a motor, by means of circuits which will preserve independence of generated phase and utilize the same, as such, in the motor.

Mr. Betts asserted that Bradley's application and description is too vague. He had no thought of utilizing the difference of phase as a source of power. This, he thought, is conclusively shown by the fact that the only specific description contained in his original application, in connection with the initial production of two phases, is accompanied by the description of the running together of such phases and the production of "one single alternating current" by combining the two currents "by induction" by means of a converter.

When Bradley came to patent his device, five months after Tesla's patent had been granted, he erased the figure illustrating the transformer for running together the two phases by induction, so as to produce "one single alternating current," and he struck out that part of his description. This action was significant and decisive against the contention that he had knowledge of, or described, any use of two-phase currents generated and propagated and utilized as such.

Coming to the broad question of infringement, Mr. Betts noted that the principal contention of the defendants was that they did not use the "independent" circuits of Tesla, and also that the interposition of converters for letting down the current was a differentiation. The latter point he dismissed as idle, Tesla's system

being devised for the very purpose of high potential transmission and low potential use. The contest hinged upon the meaning of "independent circuits." Mr. Betts argued that the language used in a patent is almost necessarily less than the idea. The invention is larger than the form in which it is expressed, and the courts have even gone so far in carrying out that rule—when an invention before them is of an important character, and is important and valuable because it is capable of being expressed and embodied in a great variety of forms—as to disregard the literal wording of the claims if the substance of the invention has really been appropriated by an infringer. Nothing can be more pertinent on that point than the ruling of the Supreme Court in Hoyt vs. Horne.

It was true that the defendants connect the circuits of their generator at one end to each other, and the circuits of their motor in delta form, and that they use three transmitting wires in place of the six which Tesla illustrates in his several figures. But, none the less, the circuits of their generator and transmission circuits and the motor circuits, act independently, in so far as they preserve and utilize independence of phase, precisely in the same way as do the isolated circuits used in Tesla's illustrations. Besides, the defendants did not invent the "three-wire" system of electrical transmission, nor the practice of utilizing, in independent circuit systems, such parts of connected circuits whose use did not interfere with the appropriate work of those portions of the circuit which were in fact separate. Mr. Betts cited the proposal of three wires, with phase difference of 120 degrees, for the Lauffen-Frankfort transmission in 1891, and pointed out that Tesla himself in his paper of May, 1888, said of the economy of wires in connection with the two-phase system, "Instead of using four wires with like result, three wires may be used, one forming a common return for both circuits." In other words, and, in short, "independence" did not mean "isolation," and it was the phases of potential or varying pressures that were to be kept separate from each other, not the "currents." The defendants admitted that the generator which supplies their motor system with energy generates three alternating currents of differing phase of potential—that is, the time of reaching maximum and minimum potential in the circuits is 120 degrees apart. The potential thus generated in the three circuits of the generator is transmitted with the "independence" of phase, and time relation thereof, unimpaired, to the motor, and such potential, acting in the circuits of the motor, generates in such circuits three alternating currents of differing phase 120 degrees apart, and such currents in the motor produce a whirling field of exactly the same character as would be produced if the wires were six in number, instead of three.

No one could tag an atom of water any more than they can tag a vibration of electricity, and assert that it is the same atom or the same vibration which generated the pressure initially, which also transmitted and utilized it finally. "Pressure," or "potential," is the vital thing, and, if potentials of three different phases be produced and transmitted independently and utilized in a motor, it is of no importance whether such pressure was transmitted through three pipes or three wires, or six pipes or wires. The statement that the electromotive forces "so cancel out," when opposing each other, that there is in each circuit nothing but a current differing in phase by 120 degrees from the current in other circuits, is easily illustrated by diagrams.

As to the patents in suit, No. 381,968, was in dispute as to claims 1 and 3, touching the use of the word "independent," and as to the employment of an annular or ring shaped field magnet as a unit, the core and the winding to be regarded as a whole. Patent No. 382,280 was a claim for the "method." Mr. Betts remarked that a method of operation may be patented as a distinct invention from the apparatus which operates thereby. In the Bell Telephone case, the claim was for both the method and apparatus. The apparatus described by Bell was entirely different from that of the defendants in the several suits, and there was no infringement of the claim, so far as it was a claim for an apparatus, but the Supreme Court sustained the claim for the method and held that defendant infringed. This could not have been if the two inventions were exactly the same. In 94 F. R., p. 868, Judge Shipman, in a case on another Tesla patent, relating to a modification of the same system as that of the patent in suit, ruled that a claim for the "method" of operation was not void as covering merely a mode of operation or function of certain machines.

Patent No. 382,279 was for a motor having closed coils or closed inducing circuits on its armature. Infringement was not denied as to the first and second claims, unless the word "independent" is given the restricted meaning which was held to be untenable.

Infringement of the third claim was denied on the ground that the defendants' magnet is not "an annular field magnet," but this was due to the misapprehension of the meaning of the phrase, as noted above.

Mr. Betts touched last upon the decision of the Imperial Court of Germany, under which Tesla had been compelled to erase his broader claims and take refuge in limited phraseology. With regard to this, Tesla, admitting that the invention had not been "worked," in a strict sense, sought to have his default excused, on the ground that he had offered to license some one, and that infringers had adopted his method and claims by utilizing what is termed the "rotary current system," with three conductors instead of six. The court held that, in view of the limitations of his patents, and in view of the striking out of his claims as first presented, and in view of the substitution of narrow ones, and in view of the fact that certain explanatory language, as to what was meant by "independent" circuits, having been originally in the specifications, but stricken out, they would not give to the patents the broad construction which would enable Tesla to save them by relying upon the work of infringers as a statutory "working" of his invention. The German court went on to say that, even if the explanatory sentences had been left in, they would, nevertheless, have come to the same conclusion. But this was obviously a mere obiter dictum. No such question was before the United States Court, as the sentences had, in fact, been erased before the patent was issued.

But a more important fact came up in the German case, namely, the Ferraris publication in April, 1888, at Turin, of analogous ideas. This pamphlet had been distributed abroad, and was therefore part of the prior art there, and the German patents of Tesla could only be valid if at all, for specific construction. But the Ferraris lecture had no place in the prior art in the United States, and had not been invoked here by the defendants. "Here," concluded Mr. Betts, "Tesla is a primary inventor, being the actual originator of a new method of electrical transmission of power, which has revolutionized industry."

Meeting of the National Electrical Trade Association.

The sustained interest shown in the work of the national and local electrical trade credit societies is an excellent sign of health and strength, and it would appear that as the result of the efforts put forth, credits were never in better condition than they are to-day. The amounts protected run actually into the hundreds of thousands of dollars, and while a load of anxiety is lifted from the minds of members, the man of honest purpose and good standing can get all the legitimate credit he needs from them, while the dubious purchaser has his opportunities greatly restricted.

The National Electrical Trade Association held its general meeting in Boston on Nov. 10, when outside cities and the board of management were represented by Messrs. C. W. Wilkins, of Partrick & Carter, Philadelphia; W. M. Carpenter, Western Electric Company, Chicago; F. D. Lawrence, Standard Electric Company, Cincinnati; R. E. Gallaher, New York Insulated Wire Company, New York City; C. P. Geddes, Sprague Electric Company, New York; W. S. Barker, New York Insulated Wire Company, Boston. They were met by Messrs. F. Ridlon and C. W. Price as the entertainment committee of the Boston Electrical Trade Society or credit association, and every attention was shown the visitors, while the entire local body to the number of over 20 members took part in the various proceedings. The vistors were invited to a cosy lunch at the Exchange Club, Mr. Ridlon presiding, and with the cigars and coffee an experience meeting was begun when those who had participated in this beneficial movement gave some most interesting details of the work that had been accomplished in the purification and strengthening of credits in the electrical trade field. This lasted until about 3 p. m., when a suite of rooms at the club having been placed at the disposal of the National Association, the annual business meeting began. The members remained in session for over three hours, and a remarkable amount of business was disposed of. A new constitution and new by-laws were adopted, which will undoubtedly do much to further the aims and enlarge the scope of the association's usefulness. A most important step was foreshadowed in the adoption of resolutions favoring the establishment of a Credit Bureau to give advance information, etc., and circulate data as to the

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several thousands of accounts falling within the widening range of electrical industries, with newcomers in large numbers every year. The general secretary also presented a valuable report going into the details of the workings of the body. Copies of this will be sent to all the local societies and members.

The association then proceeded to the election of officers for 1899-1900, and Mr. C. W. Wilkins, of Philadelphia, was elected president; Mr. W. M. Carpenter, of Chicago, vice-president, and Mr. F. P. Vose, of Chicago, general secretary and treasurer. No change was made in the board of managers. After the transaction of a lot of hard and serious work, with most gratifying results, the association adjourned. But the hospitality of Boston was not by any means exhausted yet. A beautiful little dinner was provided at the Exchange Club, and then automobiles took the whole party to the theatre to see the performance of the "Man in the Moon," a gentleman whose bland countenance and subtle evasiveness were full of pathetic but humorous reminders of other men on this earth of ours, whose bank accounts are of a subjective and inductive nature and whose payments are liable to disastrous prolongation and retardation.

The Berliner Telephone Patent Litigation.

The suits brought by the American Bell Telephone Company against the National Telephone Manufacturing Company, et al., and the Century Telephone Company, et al., for infringement of the famous Berliner patent are now before Judge Brown in the United States Circuit Court, Boston, and the hearings have continued during last week and this week. The case closed on Tuesday, with argument by Mr. Betts. Judge R. S. Taylor and Mr. E. P. Payson have appeared for the defense. Mr. F. P. Fish as usual represents the Bell interests, with F. H. Betts, G. L. Roberts, W. W. Swan and W. K. Richardson.

These two suits were brought by the Bell Company by bills in equity, alleging infringement in each case of letters patent of the United States No. 463,569, dated Nov. 17, 1891, and issued to the complainant as assignee of Emile Berliner. Only the first and second claims of the patent have been put in issue. The record is almost identical in each case, with a single exception of the short deposition of Mr. Metcalf, an expert for the Century Company, which is not embodied in the record of the National Company.

The Berliner patent in suit has been a subject of a suit brought by the Government of the United States to annul the patent, which suit is referred to in the present cases. In that case, it will be remembered, the United States Supreme Court refused to annul the patent, despite the claims of irregular practices in the Patent Office. One of the defences set up in this case is based upon certain early work of Mr. Edison, and by agreement between the parties the defendants have introduced in evidence certain portions of the record taken on behalf of Mr. Edison in the "speaking telephone interferences." The only substantial issues made by the defendants in these cases, the complainant claims, relate to the validity of the claims in issue of the Berliner patent.

Both defendants contend that the Berliner patent was invalid because of the issue to Berliner on Nov. 2, 1880, of a patent, No. 233,969, which was issed for the Berliner receiver as a division of his patent here in suit. It is maintained that the two patents are for virtually the same thing. The complainant claims that this is the only defence which is advanced in the testimony of the Century Company's expert, although it understands that the Century Company joins in the defences set up by the National Company.

The National Company contends that Berliner's patent in suit is limited in term by the issue to him, in 1880, of various foreign patents—now expired—for sundry small improvements on his broad microphone invention, the subject of the patent in suit. These foreign patents correspond with various United States patents for such improvements, which were applied for by him two or three years after his application for the patent in suit. The complainant claims that this point is without force.

The National Company further contends that Berliner's application as originally filed was unlawfully amended, but the complainant undertakes to show by analysis of the proceedings preliminary to the grant of this patent that the amendments made by Berliner were such as are clearly permissible, and, indeed, prescribed by the statutes. The National Company contends that "the Bell liquid transmitter," briefly referred to in Mr. Bell's great telephone patent of 1876, was a microphone, and anticipated Berliner. This instrument has been well known as an early experiment since 1876, but nobody ever thought of its being a microphone, the complainant alleges, until the suggestion was made in 1896 at the final arguments of the Government suit, and the complainant further avers that there is no merit in the argument. It is also contended by the National Company that Berliner was anticipated by Edison as the inventor of the microphone, but the complainant claims that Mr. Edison himself never advanced any claim to the microphone, although he was diligent in applying for patents on telephone improvements; and the complainant proposes to show by an analysis of Edison's crude sketches and early experimental work that there is nothing therein which anticipates Berliner.

The Century Telephone Company, one of the defendant corporations, asks this question in its brief: "Can the Bell Company have the monopoly of the telephone for thirty-two years?" and continues thus: "The telephone current is an electric current, similar in form to sound waves. The monopoly of that current ceased in March, 1893, on the expiration of the Bell patent of March, 1876. That patent fully describes two ways of producing a telephone current: (a) by varying electromotive force; (b) by varying resistance. It will be assumed for the purposes of this branch of the argument, that Berliner discovered a new way of varying resistance much better than any way of varying resistance known to Bell, and that Bell was entitled to the monopoly of the telephone current for a reasonable term, and Berliner was entitled to the monopoly for a reasonable term for his better way of producing the telephone current. Both these monopolies were bought by the Bell Company more than seventeen years ago, that is, before 1880; up to March, 1893, the Bell Company had full enjoyment of both these monopolies, for the reason that the greater, or Bell, monopoly of the current, includes the lesser, or Berliner, monopoly of a better way of producing the current.

"The Bell Company now asserts that as a strict matter of law it owned only the Bell monopoly up to Nov. 17, 1891, and an inchoate right only to the Berliner monopoly up to Nov. 17, 1891; and that although it owned both monopolies from that date up to the expiration of the first Bell patent, in March, 1893, it has owned only the Berliner monopoly since March, 1893, and that there is nothing in these facts which make it improper for the Bell Company to enforce the Berliner monopoly up to November, 1908."

The Century brief says: "This assertion is an affront to public opinion, for the truth is that the public has paid the Bell Company many times a king's ransom, and it is simply monstrous for the Bell Company to assert that it has a right to continue its exactions for thirty-two years after the application for the Bell patent was filed, and for thirty-one years after the application for the Berliner patent was filed. The Berliner 1891 patent is void for the reason that one claim, at least, is void. A patent void in part is void in whole, unless it can be saved under the disclaimer law, sections 4917, 4922 and 973; and that law does not apply to the Berliner patent of 1891."

Telephonic Development in Michigan.

From 1881 up to the present year the laws of the state of Michigan have provided for the taxation of telephone and telegraph companies upon a valuation made by a state board consisting of the auditor-general, state treasurer, and land commissioner, from a showing made to them by the companies.

The law has been changed this year, so that the taxation hereafter will be 3 per cent. of the gross earnings.

The valuation placed upon the different telephone companies of the state by the board of state officers on July 1, 1898, was as follows: Bell companies: American Telephone & Telegraph Co., $70,000; Michigan Bell Telephone Co., $1,118,600; total, $1,188,600. Independent companies: Citizens, Grand Rapids, $115,000; Citizens Mutual, Grand Rapids, $10,000; Citizens, Muskegon, $20,000; Kibbe Telephone Co., $5,700; Marquette County Telephone Co., $30,000; Menominee Range, $6,800; Owosso Telephone Co., $10,000; Ottawa Telephone Co., $5,000; Sagatuk & Ganges, $5,000; Twin City, St. Louis & Benton Harbor, $14,000; Detroit Telephone Co., $517,000; New State Telephone Co., $144,000; Valley Telephone Co., Sag. & B. C., $115,000; Lansing Telephone Co., $25,000; National Telephone Co., St. Johns, $6,250; Tecumseh Telephone Co., $7,000; Moore Telephone Co., Cairo, $5,000; Alpena Mutual, $9,000; Adrian Telephone Co., $2,500; Citizens of Ionia, $10,000; Cheboygan Telephone Co., $10,000; Chase Telephone Co., Harbor Springs, $5,000; Central Telephone Co., Kalamazoo, $35,000;Kalamazoo Mutual, $25,000; Cadillac Telephone Co., $25,000;

Calhoun County Telephone Co., $10,000; Encampment Telephone Co., Sault Ste. Marie, $10,000; West Branch Telephone Co., $5,000; Escanaba, $5,000; Hudson Telephone Co., of Dowagiac, $5,000; 30 companies at $5,000 or more each, $1,207,250; 35 smaller companies had largely increased the valuation of their property.

During the year and three months some of the independent companies had largely increased the valuation of their property. No independent company, large or small in this state, had disposed of its property to the Bell Co.

CURRENT NEWS AND NOTES.

AUTOMOBILES VERSUS HORSES.—Some curious statistics in connection with automobilism versus horses in France have just been published. It appears that in the month of October there were 906 accidents caused by runaway horses, in which 92 persons died. During the same month there were only 23 automobile accidents, in which two victims were badly injured, but there were no deaths. In France this is taken as conclusive evidence of the superiority of the automobile. The same inference would be natural and fair in any other country.

ELECTROMAGNETIC BRAKE.—A patent was granted Nov. 7 to Frank C. Newell on a track brake device intended more particularly for use on electric cars. In addition, the application of the track brake-shoe also actuates mechanism to set up wheel brakes. The gist of the invention lies in the utilization of the inertia of the moving car after its motor or motors have been disconnected from the trolley, when connections are made causing the machines to act as dynamos and supply the current necessary for energizing the brake magnet so as to set both the track and wheel brakes.

MEETING OF MUNICIPAL LEAGUE.—The fifth annual meeting of the National Municipal League will be held at Columbus, O., Wednesday, Thursday and Friday of this week. The most important business of the coming meeting is the discussion of the "Municipal Programme," which aims to present a form of government under which municipalities will be least subject to corruption and offer most advantages for substantial growth. It includes a municipal corporations act, which proposes some radical changes in the present municipal systems and makes ample provision for municipal ownership and operation of franchises and for the reform of the civil service.

DRY BATTERY.—In a patent issued Nov. 7 to Charles E. Burroughs a construction of dry batteries is described having for its object to increase efficiency and cheapen construction. The usual carbon cylinder or rod surrounded by a mixture of pulverized plumbago and lamp black is wrapped with a strip of absorbent cotton or other absorbent material. The absorbent material is then saturated and enclosed between the two halves of a split zinc cylinder forming the positive electrode, and the whole entered into a cylindrical outer case; the parts being all held in place by expansion of the compressed absorbent material, the desired intimate contact of the surfaces is thus secured. Above the cylinder in the case is placed a horizontal layer of absorbent material above which a fluid proof partition is arranged, on which is a layer of dry absorbent material, the top being finally sealed in by tar or wax compound poured on top of the last mentioned layer of absorbent material.

COMBINED ELECTRIC AND GASOLINE AUTOMOBILE.—A patent issued Nov. 7 to Edouard Henriquez, of Brussels, Belgium, describing an automobile which is supplied with a gasoline engine, an electric motor and storage battery. By a combination of gearing, clutches and switches, either the engine or the electric motor can propel the carriage; or the engine can drive the motor for charging accumulators; or the engine and motor combined can propel the carriage. The arrangement of gearing is such that the carriage can be propelled forward at two different speeds and backward at a reduced speed, while the engine or motor works at full speed at full load. The principal object of the accumulator is that it may be used while passing through streets, thus avoiding the smell of the exhausted oil vapor. The engine only would be used on level roads in the country, and the generator and engine together for running up steep or long gradients. The patent describes in detail all of the various gearings and electrical connections incident to the system.

DYNAMO REGULATION.—In a patent granted Nov. 7 to Charles A. Brown, a method of dynamo regulation is described based upon the use of a "booster" in the field circuit of the generator. The field of the booster has two windings, one of which is in series with the dynamo armature and the other in shunt across the mains of the working circuit. By this arrangement the strength of the fields of the main generator is controlled directly by the counter e. m. f. exerted by the booster, and indirectly by the resultant field produced in the booster by the combined effects of the compound windings above mentioned. The two fields of the booster are wound differentially, and its armature is rotated at a speed proportional to that of the armature of the main generator—in the case of a belted machine, for instance, being belted to the same shaft. In operation, when a number of translating devices are cut out of the main circuit, the resulting decrease in the current flowing therein will by reason of the differential windings of the booster increase the magnetic field strength of the latter, in which case it will act as a motor. When translating devices are being cut into the main circuit, the field strength of the booster will be reduced, its counter e. m. f. will be overcome and it will be driven as a generator. Thus in both instances it will act automatically to compensate for change of potential in the working circuit.

TRANSMISSION OF SOUND.—A patent was granted Nov. 7 to Prof. Elisha Gray on a new way of ringing a bell based upon what is claimed to be the discovery of a new sound. The method is more particularly applicable to a system of submarine telegraphy. On an axial stem within a bell are mounted magnets arranged at right angles to each other; there are eight coils, one over each limb of each magnet, and these coils have independent connections by means of a cable to the transmitting apparatus above the water. On the rim of the bell are secured four laminated armatures equally spaced about the rim, each armature forming part of the magnetic circuit of a pair of opposite magnets. Assuming the bell to be submerged in water, the cable leads to a tuning vibrator connected to a source of electric current, which vibrator is given a rate of vibration corresponding to the rate of vibration of the bell. Owing to the fact that experiment has shown that at the rate of vibration desired for the purpose in view, not more than one-half ampere can be transmitted through a contact, there are four contacts on one side of the vibrator for one-half of the magnets and four contacts for the other half of the magnets on the other side of the vibrator; consequently, at each vibration the contacts on either side permit two amperes to pass through the magnets. The magnets are arranged in two sets such that at the contact on one side magnetic attraction will be exerted on the bell at right angles to that following contacts on the other side. Unless the vibrator is tuned to accord with the bell, the latter will give forth no sound, even though current be passing. When in tune, however, the bell will ring with a round musical note, from which all overtones are eliminated, such as are present in a great number when a bell is struck with a hammer. It is stated that by this means sound can be transmitted through water over great distances, and, moreover, with a velocity four times greater than that of sound in air. The receiver for these sounds consists of an iron frame submerged in the water having stretched within it a thin iron or steel diaphragm, which may be tuned by means of stretching bolts and nuts until its natural rate of vibration is in accord with the bell from which it is receiving signals. In relation to the face of the diaphragm is a telephonic arrangement connected electrically with an ordinary telephonic receiver at the receiving point. At the transmitting end of the line the current may be sent into the bell so as to cause it to give sounds of shorter or longer duration corresponding to Morse signals; and at the receiving end these signals are audible through the telephone. Another patent issued to the same inventor on the same date describes a method for applying alternating currents for the operation of the bell, thus dispensing with the above-mentioned vibrator. As in this case it is necessary for the frequency of the alternating currents to be maintained constant, the patent describes a very delicate governor for the generating apparatus. This consists of a light rotary centrifugal circuit-maker and breaker which may be adjusted while in operation. This governor acts to throw a resistance in or out of the field of a motor running the alternator, thus governing its speed so that the alternator may be driven at a constant rate.

CUBAN TELEGRAPHS.—A recent storm is reported by cable from Havana as having destroyed 200 miles of reconstructed military telegraph lines in the Holguin district of Cuba. The island still has to depend largely upon submarine cables for its intercommunication.

ELECTRIC RAILWAY RETURN CURRENT.—A patent was issued Nov. 7 to Walther Kramer, of Hagen, Germany, for a method of preventing electrolysis from electric railway return currents. The rail is enclosed within a trough-like shield of conducting metal, which shield is connected with the same pole of the dynamo as are the rails!

A CURIOUS ACCIDENT.—David Evans, a boy 14 years of age, recently met his death in a peculiar manner. He fell asleep at the Cleveland Steel Works, at Eston Junction, England. On waking he stretched out his arms. One of his hands came in contact with an electric light wire and he was immediately killed by the electric shock. An inquest is being held on the lad's death.

APPROACHING THE ABSOLUTE ZERO OF TEMPERATURE.—Prof. Dewar has now succeeded in solidifying hydrogen, thereby obtaining a temperature only 14° to 15° above the absolute zero. The melting temperature of solid hydrogen is about 16°, and by evaporating it he obtained a temperature a few degrees lower. Solid hydrogen seems to be a transparent ice, and not a metal as was heretofore supposed.

THE PAN-AMERICAN EXPOSITION.—The work for this show is being steadily carried on at Buffalo, and considerable progress has been made. Mr. Luther Stieringer, its consulting electrical engineer, says that one feature will be the basin in the main court, on an inclined plane, with a series of cascades fed by an immense fountain in front of the electrical tower. The basin will be 800 feet long and from 250 to 400 feet wide.

ANOTHER CALIFORNIA TRANSMISSION PLANT.—The Truckee River General Electric Company has completed its plans for a generating plant on the Truckee River, to transmit power for use in the celebrated Comstock mines, some 30 miles distant. The first installation consists of two 750-kw generators driven by turbine water wheels, to be operated either under 85 or 110-foot head, to be decided later. The transmission voltage will be 20,000 and the current will be distributed in the mines at 2200 volts.

SANITARY TELEPHONE MOUTHPIECE.—In our issue of last week we noticed two patents on sanitary attachments for telephone transmitters, and in the budget of patents for the current week there is still another patent granted to William Lenderoth on the same kind of device. This consists in the use of a cheaply made attachment of wire readily applied to the mouthpiece of a transmitter, and designed to hold a paper cone which may be removed and destroyed after speaking into the transmitter.

FUSIBLE CUTOUTS.—Two patents were issued Nov. 7 on fusible cutouts, one to Joseph Sachs and another to Charles Proteus Steinmetz. The former relates to a means of indicating when an enclosed fuse is blown, the device consisting in the use of a wire of extremely small cross-section in shunt with the main fuse and passing longitudinally over the exterior of the case. The Steinmetz patent is on the use of an explosive compound, such as acetylide, surrounding the fuse over a portion of its length. When the fuse is heated to a predetermined point, the compound will explode, thus shattering the fuse and rupturing the arc that might otherwise be maintained, in consequence of the blowing of the fuse.

SINGLE-PHASE INDUCTION MOTOR.—A patent was granted Nov. 7 to Thomas Duncan on a single-phase induction motor, involving the use of a condenser. Assuming a two-phase motor field with four polar projections, two opposite poles carry each a single coil and the other two opposite poles two coils, one large and one small. The smaller coils on the latter poles and the two coils on the other pair of poles are connected in series with each other and with a condenser, this series circuit being connected across the supply circuit. The two larger coils accompanying the smaller coils are connected also in series and across the main circuit. The condenser is so adjusted that its capacity just neutralizes the self-inductance of the two large and two small coils with which it is in series. The result of this arrangement is the production of two magnetizations in quadrature, one being in phase with the impressed e. m. f. and the other 90 degrees behind it, thus giving a true two-phase rotary field.

AUTOMOBILES TO HANDLE MAIL.—The proposition of Postmaster Wilson, of Brooklyn, N. Y., to introduce automobiles into the postal service in that borough has excited interest. Mr. Wilson has received a number of offers from manufacturers for the supply of the vehicles. The idea of employing automobiles in the postal service in Brooklyn is said to have evolved from the refusal of the Brooklyn Rapid Transit Company to make any reduction in the charge per mile for carrying the mails. "I am convinced," said Mr. Wilson, "that the use of automobiles in the service is entirely practicable. We now pay 12 cents per mile for all mails carried, and it costs the Brooklyn office $72,000 a year to handle the mails. As I figure it out we can make a saving of fully 25 per cent. of this amount with automobiles, and at the same time greatly improve the service. I believe that Brooklyn will be the first office to adopt this system. Anyhow, the matter is being carefully investigated." Postmaster Van Cott, when questioned about the plan of Postmaster Wilson to use automobiles in the collection and delivery of mails, said: "Automobiles might be used to advantage in the uptown districts, but I am convinced they would not be as available in the service downtown as the gigs we now use. They would be more cumbersome, and could not dodge in and out of a tangle of cable cars, trucks and other vehicles, as the gigs do."

CONSTANT CURRENT TRANSFORMER SYSTEM.—A patent was issued Oct. 31 to Walter A. Layman and Fredinand Schwedtmann, of St. Louis, Mo., on a transformer system for maintaining a constant current for alternating current, arc lighting and other constant alternating-current circuits. The transformer consists of the usual primary winding and of a sectional secondary winding. By means of automatically-controlled regulating devices, sections of the secondary winding may be cut out in order to keep the current constant, should the potential of the circuit vary. Taps brought out from the secondary winding are connected to terminals on a switchboard, the terminals being arranged concentric to the axis of rotation of the switch arm. Means are provided for giving motion to this switch arm so as to cause it to cut in or out sections of the transformer secondary. This motion is controlled by the action of two solenoids, one in the lamp circuit and the other fed from the secondary or primary circuit proper. If, for instance, it becomes necessary to increase the e. m. f. of the secondary in order to maintain the current in it constant, the solenoids cause a mechanical engagement which produces motion of the switch arm in one direction; and should it be necessary to reduce the second voltage, the solenoids act to cause a mechanical engagement that will give motion to the switch arm in the opposite direction. The advantages claimed for this system over other constant alternating-current systems are that, first, the current coming from the dynamo always has a high power factor and is in proportion to the number of lamps burning in the arc circuit; second, the arc circuit is at its maximum efficiency, since no resistances are introduced to take the place of lamps which temporarily or otherwise are cut out of circuit; and third, the transformer works at its maximum efficiency, as the losses therein are in a measure proportionate to the effective work being done in the circuit. In addition, a short circuit in the system is taken care of by the arrangement described and in case a transformer is cut out of circuit, the mechanism operates to turn the switch arm to its zero position ready for the next start. This system, we understand, is to be placed on the market by the Wagner Electric Company.

LETTERS TO THE EDITORS.

Professional Degrees.

To the Editors of Electrical World and Engineer:

Sirs:—I do not think it makes much difference whether the degree of M. E., E. E. or C. E. is given at the end of a four years' course, or as a second degree, provided the practice is uniform. It is desirable to have a higher degree than that which is given for undergraduate work, and many institutions have set aside the de-

gree of M. E., etc., for this purpose. It is unfair to graduates of such schools who may have done advanced work to obtain the degree of M. E., E. E. or C. E. when another institution grants the same degree for simple undergraduate work.

If the degrees in question are to be reserved for higher degrees, I think a man should spend at least two years in engineering work before becoming eligible.

In general, I favor the requirement of a thesis for these degrees as a safeguard against a loose and indiscriminate granting of degrees to all candidates that are technically eligible. In cases where there is no doubt about the merit of the man, the presentation of a thesis might be waived.

I suppose that the engineering profession would judge the degree by what it represents. The value of the degree would depend upon what institution granted it quite as much as upon the title, and both would be considered together.

Rose Polytechnic Institute,
TERRE HAUTE, IND. FRANK C. WAGNER.

To the Editors of Electrical World and Engineer:

Sirs:—Replying to Mr. Rimanoczy's inquiries regarding "professional degrees," etc.: Technical schools confer the degree of M. E., E. E. or C. E. as a certificate that the recipient has had a specified amount of training and that his instructors hope he has a "capacity for becoming an engineer."

There are engineers and engineers. In a real sense, the fresh graduate should be an engineer capable of immediately taking responsible charge of certain kinds of engineering work. Of course, he should be more of an engineer later.

The technical schools aim to give the students not only a theoretical basis for future work, but also sufficient practical experience to make the theory their own. As one example, every senior student in the electrical engineering course at the University of Minnesota takes his turn in operating and caring for the boiler, engine, dynamo, motors, lamps and circuits of the university lighting plant, and he is held personally responsible for the proper operation of the plant. As a general rule the students secure work with some lighting, street railway, contracting or manufacturing company during the vacations, thus supplementing their university work by actual commercial experience. A result is that immediately after graduation numbers of the students have taken charge of central stations, some have begun successful careers as contractors, some have entered the employ of various companies.

To cite an individual case, in one of the public buildings of this state is a 75-kw direct-connected generator designed by and constructed under the supervision of one of our students within a year after his graduation; the engineer in charge of the plant states that this machine operates more satisfactorily than two other machines in the same plant having equal rated capacity and made by one of the largest companies in the country. Similarly good work is being done by the graduates from other courses, both in this and in other technical schools. It therefore may not be presumptuous to feel that our students are engineers by the time they complete their technical course.

Each candidate for graduation from an engineering course must submit a satisfactory thesis embodying the results of the investigation of some engineering problem, which shall demonstrate his engineering ability. Such investigations are always worth much to the student and sometimes produce results of general value.

Without making invidious comparisons, it is believed that the average engineering school has higher entrance requirements and a longer course of study than has the average medical college; also, that the engineering student has more "clinical work" during his course and is thrown more upon his own responsibility than the medical student. Certainly the young engineer is not so apt to make grave mistakes as is the young physician.

University of Minnesota,
MINNEAPOLIS, MINN. GEO. D. SHEPARDSON.

To the Editors of Electrical World and Engineer:

Sirs:—The subject of the significance of engineering degrees is one of considerable moment at the present time with its rapid development of technical education; and the inquiries made by your correspondent, Mr. B. Rimanoczy, in the issue of October 21 are sufficiently clear to merit discussion as they stand.

A further inquiry might have been advanced: Are the engineering degrees, M. E., etc., entitled to be classed as learned ones, as the term learned is usually applied to law, medicine or divinity? In passing to the leading questions it may be said that, until the literature of engineering and to some extent that of applied physics, becomes more distinctly literary in its methods and reaches a higher intellectual plane, the general public will not readily accord the title of learned to one versed alone in engineering lore.

Considering now the questions raised by your correspondent:

1. "Should the M. E., C. E. or E. E. degree be conferred after four years of undergraduate work?"

An examination of the practice of the leading American technical schools and the technical departments of our universities, reveals a singular disagreement in the practice of awarding the degrees enumerated. In a synopsis before me, four of our leading universities grant such degrees in full upon the completion of their prescribed four-year courses. Two of our oldest and best known institutions devoted exclusively to technical education grant at the end of the regular course, the degree of Bachelor of Science in Engineering, and bestow the full engineer's degree, in one case after three years of practical work, and in the other after seven years; though this time may be shortened by graduate work.

Quoting from a specific catalogue: "The degree of C. E., etc., will be conferred upon Bachelors of Science of Engineering who shall have been engaged for not less than three years in successful practice in positions of responsibility, and who shall present acceptable theses upon subjects pertaining to some branch of engineering."

2. "What time after graduation should a man be required to spend in engineering work before he is eligible for the full degree?"

The reply must follow a satisfactory definition of the engineer. If engineering practice were wholly a function of rational and empirical formulas and precepts, a man would be readier in the use of such things immediately after the routine of the scholastic period and would be most eligible for his degree upon graduation. No one, however, familiar with the subject would accept this definition as the whole truth. It is too partial and must be qualified by stating that engineering is applied trained judgment and knowledge. This requires experience and the maturity which comes only after some years of responsible practice. No prescribed routine of study, alone, can make an engineer; there is always a large personal element to be reckoned with, and so no definite time may be set for granting a full degree after graduation. The time to grant it is indicated rather by achievement which shall indicate by evidences of the responsible use of engineering knowledge that sufficient maturity of judgment has been attained to warrant the bestowal of a degree which implies a fitness for large trusts and carries with it a high degree of honor.

3. "Should a thesis be required for these degrees?"

Present practice generally requires a thesis to be submitted for the full degree, as well when granted upon graduation as when granted a few years subsequently. There is already a sentiment developing amongst educators which looks with disfavor upon theses prepared in the scholastic course of four years, and it is likely that this feature of our engineering courses will either be greatly modified or altogether omitted.

The thesis, however, which has been prepared after some years of practice and when more time is at the disposal of the writer for research in the literature of his subject, will usually possess considerable, and in some cases, especial value. The practice is undoubtedly a good one.

4. "What does the engineering profession think of the above degree held by men just out of college?"

The question has already been answered by inference. An intelligent practicing engineer regards a degree of M. E., etc., granted upon graduation from an institution of known standing, with respect for its representation of years of hard and well-directed study, supposedly on the lines of the most advanced literature of his subject, of which he probably has not had the time to completely avail himself. However, his own experience has taught him that judgment is such a large element in successful practice that he looks upon the freshly degreed man as a potentiality rather than a reality; and he usually suspends his estimate until a few years of practice shall have developed excellence or shown weakness. This, of course, assumes that the young man is reasonably free from a foolish and boastful self-confidence.

5. "Is the M. E., E. E. or C. E. degree as legitimate to its holder as M. D. is to the graduate of a medical college? In other words, is a young doctor more proficient than a young engineer?"

The term "legitimate" refers to a standing-at-law; and in cases where this question has arisen, the two classes of degrees seem to rest on a like basis.

In general, a young physician and a young engineer now stand, upon graduation, on a somewhat similar footing. If the courses in one of our universities operating professional schools of both engineering and medicine be examined, these two professional courses will appear to be quite similar in character and scope, with the added superiority of the mathematical over the empirical sciences. In neither case is practice emphasized; and a young man with a newly-received degree of M. D. is no more a physician than is he of the degree of C. E. a civil engineer, if the term civil engineer longer has a definite meaning. The elements lacking in each case are practice and applied judgment.

In the conclusion of such a discussion it is in order to advance an opinion which has matured as year by year the writer has watched young men go from the school into engineering practice. The value of the young man to the profession and the value of the scholastic course to the young man, would be greatly enhanced, if, say at the end of the third year of the course the student should enter the office of a practicing engineer and work under his directions and continue his studies under that of the school for one or more years; then, returning to his course he should complete the fourth year. In such a case the full engineering degree could be rationally bestowed upon graduation. Such a proposition suggests a number of contingencies which make one hesitate to advance it.

Swarthmore College,
SWARTHMORE, PA. WILBUR M. STINE.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Surging of Parallel Connected Alternators.—BOUCHEROT.—An article claiming that the formulas of Guillaume (Digest, Sept. 30) based on Kapp's theory, are wrong. He reproduces an article written by him in 1892 and applies the formulas found therein, to an example given by Guillaume. He then simplifies his former formulas and finds that the periodic time of oscillation of an unloaded alternator connected in parallel with others, is $2\pi/60$ multiplied by the number of revolutions per minute, multiplied by the square root of a ratio, the numerator of which is 20π multiplied by the moment of inertia in kilogram (mass) meters, and the devisor is the frequency per second, multiplied by the normal effective voltage and by the effective current in amperes for short circuit with an excitation giving the normal voltage at no load. The periodic time of oscillation seems to be independent of the number of alternators in parallel. It may decrease by 20 to 25 per cent. if loaded, in machines with great reaction, while it is rather constant in machines with small reaction. It is preferable to make it as great as possible as compared with the time of perturbation, and longer as the latter is stronger, and the damping weaker.—*L'Eclairage Elec.,* Oct. 28. There is a somewhat different reproduction of the same theory in *L'Ind. Elec.,* Oct. 25.

A Two-Speed Induction Motor.—A description of the principle of an induction motor designed to run efficiently at two speeds, one equal to twice the other, and intended for driving the grinding tables in plate glass works. The change is made by doubling the number of poles and consequently halving the angle through which the rotary motor moves during one cycle. The windings cover slightly more than half of the periphery, the space between them forming a pole when the connections are for half speed, in which case the poles inside of the coil are of the same polarity and those between them of the opposite polarity; while for full speed the poles in the coils alternate in polarity and there is no pole in the space between them; the reversal of the current in the winding of every alternate pole will therefore make these of the same instead of opposite polarity and will induce an opposite fall between them. The reversal is accomplished with a single 6-point switch by ingeniously connecting the windings on the Y or star system and tapping out intermediate connections such that by changing the supply leads over to these intermediate connections, the direction of the current through alternate poles can be reversed.—*Amer. Elec.,* November.

Induction Motors.—CARUS-WILSON.—An illustrated abstract of an Institution paper (read in April) giving an explanation of the action of an induction motor by means of an oscillograph, consisting of metal strips stretched in a magnetic field, a minute mirror fixed to the strips reflecting a spot of light on to a screen. By observing the movement of the spot of light, the action of a continuous or alternating magnetic field upon the metal strips supplied with an alternating current could be determined. The results thus obtained were applied to the theory of the induction motor.—Lond. *Elec. Rev.,* Oct. 27.

Low Voltage Dynamos.—GIBBINGS.—A communication referring to the article of Scott, abstracted in the Digest Nov. 11. For electrically removing wool from skins, he uses a dynamo of 1000 amp. at 8 volts, the field being separately excited from the corporation mains at 230 volts. On account of difficulties in commutation the speed of such machines should not exceed 400 revolutions per minute and the temperature rise in any part after six hours, run at full load should not exceed 50° F. above the atmosphere.—*Lond. Elec.,* Oct. 27.

EDGCUMBE.—Another communication on the same subject, questioning the practicability of the type recommended by Scott. He claims the most serious objection to be its unmechanical construction, especially the overhanging armature. He agrees that the Siemens & Halske internal pole type has done good work, but thinks that if used to any extent in the future it will be more for slow-speed dynamos at normal voltages, rather than for those for low voltages at normal speeds.—Lond. *Elec.,* Oct. 27.

Brush Rocker Details.—SCOTT.—A short, well-illustrated article describing various rocker details and bearings. The rocker should be held in a square bushing to prevent turning; a split sleeve on the spindle is recommended for enabling the brushes to be lifted together; for producing both a quick and slow adjustment a worm gearing is recommended from which the worm may be lifted for quick motions. The insulating bushings should be shellaced before assembling to prevent moisture from getting in; there ought to be efficient oil throwing grooves on the shaft. A special swivel bearing is described; chains in place of rings in the oil boxes are preferred, and are said to have proved very satisfactory.—Lond. *Elec. Rev.,* Oct. 27.

REFERENCES.

Inductor Alternator.—An illustration, with a short description, of the 600-kw Raworth-Mordey inductor alternator, recently erected at the Sheffield lighting plant. It is designed to generate current at a frequency of 100 per second, which is specially high for an alternator of the inductor type.—Lond. *Lightning,* Oct. 26; Lond. *Elec., Elec. Rev., Elec. Eng.,* Oct. 27.

Sparkless Commutation.—ISLER.—The conclusion of his paper, the first part of which was noticed in the Digest Nov. 4. Although his formulas seem somewhat complicated, he shows how they may be applied in practice and gives tables containing the values of the various factors found in actual machines.—*Elek. Zeit.,* Oct. 19.

LIGHTS AND LIGHTING.

Incandescent Lamps.—LOCH.—A paper on the relation between the power consumed and the illumination. Those lamps which yield a brilliant light at first, for a given consumption of electrical energy, show also a more rapid falling off in brightness with an increase in the consumption of electrical energy. An average consumption for a new lamp is from 2 to 4 watts per Hefner candle, while this may increase to 9 before the lamp fails. There is, however, a great difference in different lamps, even of the same makers. He made a series of experiments with a number of incandescent lamps, noting both the life and duration of brilliancy as well as the consumption of electrical energy, the results being given graphically and in tabular form. The general result showed that the consumption of electrical energy con-

tinued about the same per lamp throughout the entire test, having fallen off but slightly at the end of 960 hours, but the illuminating power diminished steadily during that time, so that the power per candle increased materially; in one case the energy per candle increasing from 2.45 watts to 6.75 watts, the candle power having fallen from 24 to 8 during the run of 960 hours.—From *Glaser's Ann.;* abstracted without the curves and tables in *Eng. Mag.,* November.

Light Efficiency of the Alternating Current Arc.—BLONDEL and JIGOUSO—An abstract of a communication to the French Society for the Advancement of Science, giving a summary of the results of their researches, as follows: The efficiency of the alternating current arc depends to a very large degree upon the nature and the diameter of the carbons, the current density and the length of arc. In comparing arcs it is therefore necessary to properly consider these points. It is not practical to try to increase the frequency; different diameters should be used for different frequencies. As the efficiency of small arcs is below that of large ones, the latter should be used whenever possible. The diameter should be reduced as far as possible with due consideration for the life, and therefore the travel of the carbon in the lamps should be increased as much as practicable. The total luminous flux is 20 to 40 per cent. less than for continuous currents of the same energy; this difference depends largely upon the nature of the carbons and the voltage used.—*L'Eclairage Elec.,* Oct. 28.

Display Illumination.—CORY.—A description of the electrical illumination of San Francisco in connection with the reception given the First California Regiment on its return from the Philippines. Some 10,000 incandescent lamps were strung on festoons across Market Street and supplied from specially installed three-wire mains temporarily run on the poles and supplied from the permanent three-wire underground mains. In addition there were elaborate illuminations of the exterior and interior of the Ferry Building, of the City Hall and of several private structures.—*Amer. Elec.,* November.

REFERENCES.

Three Arc Lamps in Series.—A short description, with two illustrations, of a device for running three arcs in series on a 110-volt circuit. It consists of a resistance which is shunted in automatically at the start.—*Lightning,* Oct. 26.

POWER.

Electricity for Auxiliary Machinery on Warships.—ROBISON.—An illustrated article pointing out that the economy of steam consumption in dynamo engines actually installed on ships, namely, 55 to over 100 per i. h. p. hours, is not satisfactory and must be improved before the use of electricity for auxiliary machinery on warships may be extended; 59 per cent. is given as a fair average efficiency of conversion of power from the steam engine to the effective power on the motor shaft, obtainable on ships, the efficiency of engine, generator, line and motor being assumed to be 93, 86, 95, 78 per cent. respectively. If the steam consumption of the engine can be taken at 26 lbs. per i. p. h., the use of an electric installation would involve the equivalent of using about 44 lbs. of steam per i. p. h. in the steam operated auxiliary machinery, which represents a reduction of 35 per cent.; if the auxiliaries now use 18 per cent. of the steam, it would require only 12 per cent. to drive them electrically. But the increase in weight is said to be considerably greater than this gain; the principal part of this increase is in the generating room; it is claimed to be at least three and a half times greater than that of a steam plant. Certain progress is also claimed to be necessary in design. Satisfactory steering engines or anchor hoists have not yet been evolved, and he believes that the installation of electric machinery is carried considerably further on the Russian battleships which are being built at Cramps', than has yet been attempted in any American ship. Some illustrations of electric auxiliary machinery are added.—*Eng. Mag.,* November.

Electric Power Distribution and the Small Consumer.—BELL.—An article showing how the centralization of power in an electric plant is able to preserve and regenerate small industries scattered over extended areas. As the first typical example, the preservation of the ribbon-weaving industry in the part of the Loire Valley near St. Etienne in France, is described. This industry had been for many generations the chief support of more than a score of towns and villages and was apparently doomed to extinction under the competition of improved machinery in city factories, when the Electric Company of the Loire undertook an electric power distribution plant. In the initial station water power was used, 900-hp being available in turbines and 600-hp in steam reserve. The three-phase system at 5200 volts was adopted. This was soon followed by two more plants, the distribution being at 190 volts for motors and 110 volts for lighting. The system has been steadily extended from town to town, and at present the total length of transmission lines aggregates 69 miles with 36 transformer stations from which power and light are distributed. From these are operated 2500 ribbon looms, 100-hp in miscellaneous motors and 8000 incandescent lamps; a ¼-hp motor serves for each loom. The charge for power to the weavers is $2 per month for each ¼-hp motor. The system has been a success. He discusses at some length the question whether such systems will pay also in other cases, and replies in the affirmative, even where water power is not available.—*Eng. Mag.,* November.

Blast Furnace Gases as Power Producer.—A very brief description of the Thwaite-Gardner system, with some figures for the average composition of furnace gases and the thermal value of the different combustible gases. Where coke is the fuel used, there are given off from 170,000 to 180,000 cb. ft. of gases for each ton of coke consumed. Thus a furnace producing 600 tons of pig iron per week and using one ton of coke per ton of iron, would deliver about 600,000 cu. ft. of gases per hour. Allowing one-third of this for heating the blast by combustion in firebrick hot-blast heaters, there are left 400,000 cu. ft. for power purposes, which would produce in gas engines 3500 to 4000-hp. For each 1⅓ to 1¾ lbs. of coke charged into the furnace, 1-hp hour is delivered. Such plants have already been installed in England and Scotland for electric lighting, in France for electric lighting and traction, and in Germany for the production of calcium carbide.—*Eng. News,* Nov. 9.

La Bella Power Plant.—A brief illustrated description of this plant in the Cripple Creek district, which was recently started and supplies light and power to the gold mining district and to a railroad. Three G. E. alternators, each of 750-kw, directly coupled to steam engines, generate three-phase currents at 6600 volts and a frequency of 60, the current being furnished consumers at this potential; the consumers are advised to instal transformers having secondary circuits of 440 volts. But little further technical information is given. —*West. Elec.,* Nov. 4.

REFERENCES.

Electrical Machinery on Board Ship.—SIEMENS.—A long abstract of his British Association paper, noticed in the Digest Oct. 14.—*Sc. Amer. Sup.,* Nov. 4.

TRACTION.

Electricity on Trunk Railroads.—The second part of the article, noticed in the Digest Nov. 11, describing the use of accumulators on the local railroad between Ludwigshafen and Mundenheim and on the trunk railroads between Ludwigshafen and Neustadt and Worms, Germany. The motor car has a storage battery of 200 amp.-hours and draws one trail car. The weight of the empty motor car is 11 tons, of the battery 9.3 tons, of the motors and apparatus 4.1 tons, together 24.4 tons without passengers; the weight of the empty trailer is 10 tons. The energy consumed on a straight level line in fair weather is 29 watt-hours per ton mile at a speed of 24 miles per hour; in very stormy weather from one side, the maximum was 44 watt-hours per ton mile. The positive accumulator plates have so far run 18,600 miles, and may last at least for 37,200, judging from their appearance; the negative plates, however, after having given 18,600 miles. showed a decrease of capacity, so that it seemed feasible to replace them. The speed of the trains is 25 to 28 miles per hour. The batteries have a capacity of 200 amp.-hours, which suffices for a distance of 18-25 miles.—*Zeit. fuer Elek.,* Oct. 22.

Voltage Drop in Rails Used for Return Currents.—BARBILLION.—A short analytical investigation. There are two losses of the potential, one due to the ohmic resistance of the rails, and the other to the leakage currents which flow in parallel through the earth. He supposes the voltage drop, due to leakage at each point, to be proportional to the difference of potential at that point between the rail and the earth, the potential of the earth being assumed to be zero throughout. He then finds that the fall of potential in the rail can be represented as an exponential function of the distance. The formula is not of a practical nature.—*L'Eclairage Elec.,* Oct. 21.

Electrolysis of Water and Gas Pipes by Return Currents.—WYNKOOP.—A paper read before the Toronto Convention of the American Society of Municipal Improvements, discussing the question from the standpoint of a municipal engineer. Electrical remedies, he thinks, have failed so far, and the problem is claimed to be a chemical one. He points out that the cast-iron water and gas mains in Brooklyn were not attacked, while they were in Dayton, and that the problem is to manufacture electrolysis-proof steel, iron and lead pipes, either

by using an alloy of pipe material that is not attacked (according to his chemical theory) by the acids set free by electric currents in the soil, or by covering the pipes with a proper paint or varnish. No particulars are given.—*Prog. Age*, Nov. 1.

Automobile.—Monnard System.—A description of a light vehicle carrying four to five passengers a distance of 80 to 90 miles with one charge. The chief feature is said to be the motor, which has two armatures "always in series" in the same magnetic field, each being geared to a wheel; the armatures are said to be traversed by the same flux (presumably meaning that they are both in the same field, each utilizing half of the total flux). It is claimed that the armatures may then have a smaller diameter and half the speed for the same ampere turns; no differential gear is necessary in this case. The excitation current is an independent one from four cells of accumulators and the six plates are obtained by various groupings of four sets of batteries of ten cells each and by varying the magnetic field. Roller bearings are used. The total weight of the motor is 55-kg; that of the 44 cells 396-kg, that of the whole vehicle with five passengers about 1000-kg; the capacity of the battery is about 115 amp.-hours and the mean current on a level at 25-km per hour 15 amp.; the energy consumed per ton-km is 47.33 watt-hours.—*La Locomotion Automobile*, June 8; abstracted briefly in *Le Mois Sc. et Ind.*, July.

REFERENCES.

Tramway Motor.—KAPP.—A long, detailed, well illustrated description of a tramway motor of the Oerlikon Co. for a one-meter gauge line, for 450 to 500 volts, and 25 amp.; a single reduction gearing 1:4.9 is used. (The description is taken from Kapp's new book on dynamo construction.)—Lond. *Elec. Eng.*, Oct. 27.

Brisbane Tramways.—A short, well illustrated description of these lines in Queensland, Australia. The overhead trolley system is used. The generating plant contains three G. E. multipolar generators.—Lond. *Elec. Rev.*, Oct. 27.

Batavia.—LIPPEGAUS.—A long, well illustrated description of the tramway which was installed by the Union Electric Co., of Germany, and is the first electric tramway in Dutch Indies. The overhead trolley system is used. There are three 500-volt dynamos, direct coupled to three steam engines of 150-hp each.—*Elek. Zeit.*, Oct. 26.

Electric Cabs in Berlin.—An illustrated French abstract of the German article noticed in the Digest Sept. 30.—*L'Eclairage Elec.*, Oct. 21.

Berlin Automobile Exhibition.—Some brief descriptions with illustrations from a consular report.—*West. Elec.*, Nov. 4.

Canal Boat Towing.—An article describing some more recent systems of mechanical traction for canals, especially that described in the article of Klingenberg, referred to in the Digest Sept. 2.—*Eng. Mag.*, November.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Municipal Ownership.—An editorial on the advantages and disadvantages of municipal ownership of electric plants. These have been remarkably successful in England, the lowest cost of production and the lowest charges to consumers being found in municipal undertakings. The most conspicuous examples of success have been achieved when the engineer has been given a free hand. Experience, however, has shown that for an engineer it is infinitely preferable to serve a company than a municipal authority; municipal committeemen are not interested in the success of the plant in the same sense as the director of a company is.—Lond. *Elec. Rev.*, Oct. 27.

Edinburgh.—A short description of a new lighting station. The continuous current three-wire system is used with lamps at 115 volts; for the outskirts there is a high tension alternating current system, at 2500 volts, transformed to 115 by local transformers. This and the older station are intended to work in parallel, and one is to be shut down at the times of light loads.—Lond. *Elec. Eng.*, Oct. 27.

REFERENCES.

English Electric Installations in 1898.—HASLAM.—The first parts of a long statistical article, analyzing the results of the operation of 50 municipal and 27 company plants in England, the figures being taken principally from *Lightning*. Tables give the number of kw-hours sold, the cost of coal, the cost of operation, the management expenses, the total cost per kw, and the average price charged to the consumer, for these 77 plants. The comparative outputs of these plants, the comparative costs of fuel and total work costs per kw-hour in 1896, '97 and '98 are given in tables and diagrams.—Lond. *El'ty*, Oct. 20, 27.

Connecting up Transformers.—An illustrated elementary article giving general rules for central station practice, showing how to connect up single and multiple transformers and what precautions to take.—*Power*, November.

Switches.—BAXTER.—In this continuation of his illustrated serial on electric switches, he describes the construction and use of multiple point switches.—*Amer. Mach.*, Nov. 9.

WIRES, WIRING AND CONDUITS

REFERENCES.

Motor Wiring Table.—A table computed for a drop of 3.6 to 3.65 per cent., giving the wire numbers in B. & S. gauge, the lengths of the wire from main line to motor in feet, and the safe current, for motors of ¼ to 10-hp, requiring 2½ to 80 amp. at 110 volts, and for motors of 1 to 20-hp, requiring from 5 to 81 amp. at 220 volts.—*Power*, November.

Insulation of Alternating Current Lines.—LEBLANC.—The first part of a long analytical investigation of the influence of the capacity on the insulation of alternating current lines.—*L'Eclairage Elec.*, Oct. 21.

Safety Suspension for High Tension Lines.—HESSE.—A French abstract, with illustrations, of the article noticed in the Digest Sept. 23.—*L'Eclairage Elec.*, Oct. 21.

ELECTRO-PHYSICS AND MAGNETISM.

Influence Machines for Röntgen Ray Work.—COTTON.—A long abstract of a paper advocating the use of influence machines for Röntgen ray work. A special form for such purposes, devised by Clark, is described; it is a Wimshurst machine without metallic sectors, and with brush collectors instead of points; auxiliary electrodes are used for introducing spark gaps of varying length, into the circuit of the tubes. The time of exposure, if used with photographic plates, is somewhat long, for the finger of an adult two minutes, for the shoulder forty-five minutes.—In an editorial note it is pointed out that for the latter ten seconds are sufficient if a good coil with a Wehnelt interrupter is used, and that many objections to the coil have been removed by the introduction of this interrupter. The influence machine has, however, some advantages and would be still more useful if its output could be increased.—Lond. *Elec.*, Oct. 27.

Moore Vacuum Light.—ELSTER and GEITEL.—A description of a modification of the device of Moore, who used a Wagner hammer interrupter, vibrating in a vacuum, producing a very abrupt and perfect break. To prevent the hammer from sticking and the current from melting off the points of contact, they keep the hammer vibrating by means of a separate electromagnet outside the vacuum tube actuated by a mercury interrupter of the Roget spiral type. The spiral and the hammer are tuned to unison, but even so the light obtained is somewhat fitful, and less steady, though safer, than the light obtained by Moore.—*Wied. Ann.*, No. 10; abstracted in *Lond. Elec.*, Oct. 27.

High-Frequency Glow Light Phenomena.—EBERT.—An investigation of the following phenomena: When a high-frequency alternating current of, say, 1000 reversals per second, is discharged through a vacuum tube in process of exhaustion, the current will increase up to a certain exhaustion, and then decrease; at the same time the potential and the energy consumed pass through a minimum. A similar reversal takes place when the pressure is kept constant and the electrodes are moved toward each other.—*Wied. Ann.*, No. 10; abstracted in Lond. *Elec.*, Oct. 27.

Analysis of the Spark Discharge.—A long article with numerous photographs of spark discharges made with a "mutograph." The sparks were produced by an induction coil and a Wehnelt interrupter. The photographs were made on a moving sensitive plate so that each shows a series of sparks as they follow each other in time. It is seen that a subsequent spark takes about the same path as its predecessor, probably becaue this path contains hot air and has a better conductivity. It appears also that the action of the Wehnelt interrupter is not quite regular, the time between two interruptions being not exactly constant.—*Elek. Zeit.*, Oct. 26.

WALTER.—An account of a similar investigation in which a mercury interrupter was used. The characteristic features of his photographs are, that a spark is preceded by some previous discharges following each other less and less rapidly; those from the negative point are smaller than from the positive, the latter ending in brush discharges. The bends in the resulting spark path occur especially at those points where the preceding discharges broke into brushes. The middle part of the path which is the part in which electric energy was stored up by the previous discharges, is considerably wider and

brighter.—*Wied. Ann.*, Vol. 68, p. 776; abstracted with illustration in *Elek. Zeit.*, Oct. 26.

Sounds Emitted by the Arc.—Jervis-Smith.—A note describing some experiments to find the effect of an electrolytic break, on a steadily burning arc. The arc was supplied from the continuous current lighting mains, and at 60 ft. distant there was an electrolytic break connected to the same mains (presumably in parallel with the arc). The arc gave out a loud, clear note of the same pitch as that of the break; the best conditions were a long quietly burning arc produced by adding a little powdered glass in the core of the positive carbon; the note was unpleasantly loud. The break was then removed to a point about a mile distant, and the same effect was produced but to a less degree, although loud enough that Morse code messages might be heard 10 or 12 ft. from the lamp.—In an editorial note regret is expressed that the investigation had not been carried farther to find the conditions of maximum sensitiveness, as this would probably have given a useful clue in the search for a loud speaking magnifying telephone.—Lond. *Elec.*, Oct. 27.

Spectro-Photometry of Continuous Current Arc Lights.—Lehmann-Richter.—A short article giving the results of an investigation made to find how the total radiation of light is made up of that from the three parts of the arc, the greenish part called the aureole, the dark surrounding mantle of flame, and the bright bluish-violet core of the arc itself. Different kinds of carbon were used, impregnated with chloride of sodium. The brightness of the sodium lines was found to be greatest in the outside aureole, less in the bright blue core, and least in the mantle of flame.—*Zeit. fuer Elek.*, Oct. 21.

Physical Properties and Atomic Weights.—Sanders—An article representing the relations between the general physical properties of the elements and their atomic weight graphically, the latter being the abscissas. Of all the properties considered, the curve of the specific heat is the only one not periodical, it is nearly hyperbolic. The specific gravity, the linear coefficient of expansion by heating, Kohlrausch's migration velocities of the ions in normal solutions of their salts, the electric conductivity, the temperature coefficient of the thermoelectric force and the potential difference between the metals and the normal solutions of their salts, can all be represented by periodic curves.—*Elektrochem. Zeit.*, October.

Leyden Jar Experiments.—Dell.—A brief description of an experiment with this apparatus for slow discharges of Leyden jars, noticed in the Digest Nov. 11. By connecting all the outside coatings of the jars together, without the tube, and then connecting a thin copper wire to the tinfoil of the pendulum and extending it some 8 ft. into the room, attaching the other end to a piece of tinfoil, the wire became brilliant with radiation.—*Elec. Rev.*, Nov. 1.

Magnetic Properties of Pyrrhotite.—Weiss.—He discovered a remarkable magnetic property of pyrrhotite. It is capable of magnetization by induction in all directions except that of the crystalline axis of symmetry. He has devised an apparatus in which a sphere of pyrrhotite is suspended by a wire and a Cardan joint in such a way that it can, by turning through 90°, be made magnetic and non-magnetic with respect to a large permanent magnet attached to the apparatus.—*Jour. de Phys.*, October; abstracted in Lond. *Elec.*, Oct. 27.

REFERENCES.

Vacuum Tubes.—Rollins.—In this continuation of his long serial, he gives some rules for exciting high vacuum tubes; he describes the phenomenon observed if too strong a current is sent through the tubes, when the amount of light and definition is not satisfactory; also experiments with a slotted anode in which the cathode could vibrate; under certain conditions be obtained rhythmic vibrations like those of a bell.—*Elec. Rev.*, Nov. 1.

Diffusion of Cathode Rays.—Kaufmann.—A somewhat longer abstract with illustration and some of the formulas and figures of the article noticed in the Digest Oct. 21.—*Elek. Zeit.*, Oct. 28.

Globular Discharge.—Leduc.—An abstract, with five illustrations, of a paper read before the French Society for Advancement of Science, which is practically the same as the one noticed in the Digest Sept. 9, 16, Oct. 7. Also abstracts of two other papers of Leduc on the phosphorescence of the glass of Röntgen ray tubes, and on rays emitted by an electrified point.—*L'Eclairage Elec.*, Oct. 28.

Laws of Electrodynamics.—Kerntler.—A French abstract of two German essays published in 1897, on the fundamental laws and especially the elementary law of electrodynamics, and on the question whether "experiments can decide between the different fundamental laws of electrodynamics." It is purely theoretical and mathematical; he rejects Ampere's law that the force between two elements of current acts in a straight line joining them, and substitutes another elementary law.—*L'Eclairage Elec.*, Oct. 28.

Electrification of Nascent Gas.—Koesters.—A somewhat longer abstract of the article noticed in the Digest Oct. 28.—*Elek. Zeit.*, Oct. 26.

Zeman Effect.—Voigt.—A mathematical theory, based upon a slight amplification of the Hertzian equations.—*Wied. Ann.*, No. 9; briefly abstracted in Lond. *Elec.*, Oct. 27.

Terrestrial Magnetism.—Eschenhagen.—A French abstract, with some figures, of the German article noticed in the Digest Oct. 21.—*L'Eclairage Elec.*, Oct. 28.

Magnetic Properties of Iron Ores.—Abt.—A French abstract of the article noticed in the Digest Sept. 16.—*L'Eclairage Elec.*, Oct. 21.

Electro-Chemistry and Batteries.

E. M. F. and Chemical Energy of Galvanic Cells.—Gross.—A very long article on the relation between the e. m. f. of a cell and the chemical energy consumed in it. He criticises some points in the Helmholtz theory and claims that the second principle of thermodynamics cannot be applied to the theory of the galvanic cell, as is done by Helmholtz and others. He then gives a theory of his own, which he tests by comparison with measurements made by others, Some of the calculated values agree well with the measured, and some do not.—*Elektrochem. Zeit.*, October.

Storage Batteries.—An editorial on the latest developments. No great departure has been made from the essential principles in the Faure or Planté cells. The tendency has been to increase the capacity per pound by diminishing the relative weight of the grid; 15 to 16 watt hours per pound are claimed for some cells at a discharge rate of one ampere per pound, but a direct confirmation of any results exceeding 10 to 11 watt hours per pound cannot be found. In traction batteries it should also be stated in conjunction with this how long the capacity will be maintained, as it falls gradually; it ought also to be stated what the renewals cost. It seems that 80-volt batteries are largely used on automobiles in England, and it is suggested to use fewer cells but larger. It is thought that there is not much more room for improvement in lead cells.—Lond. *Elec. Rev.*, Oct. 20.

REFERENCES.

Pescetto Accumulator.—Reyval.—A short article giving tables of data of this accumulator, which was referred to several times in the Digest.—*L'Eclairage Elec.*, Oct. 28.

Volta and the Voltaic Cell.—Righi.—A very long abstract of his Como Congress paper on the scientific work of Volta.—Lond. *Elec. Rev.*, Oct. 27.

Electrolysis of Chlorides of Alkalies.—Foerster.—A reply to the critical remarks of Wohlwill noticed in the Digest Oct. 28.—*Zeit. fuer Elektrochemie*, Oct. 26.

Tin.—Borchers.—A short description of the Tostedt Tin Works in Germany. Electrolysis is used in a part of the operations for refining tin, obtained from the ores. About 100 tons per month are produced and it is said to be very pure. The process is not described.—*Zeit. fuer Elek.*, Oct. 19.

Units, Measurements and Instruments.

Measuring the internal Resistance of Accumulators.—Rimington.—A description of several methods, illustrated with diagrams. In the first, the circuit is closed through two parallel branches; one contains an external resistance and an ammeter, and the current in it can be shown equal to the ratio of the voltage drop in the accumulator, to its internal resistance; the second contains an equal accumulator opposed to that under test, and a voltmeter or its equivalent; the voltage thus indicated is equal to the drop in the first accumulator, from these two, the internal resistance is calculated; but the polarization is not eliminated. In the second or zero method, the first circuit contains the accumulator under test and a resistance; the second is in parallel with the accumulator and an adjustable part of this resistance, and contains also another equal accumulator and the two coils of a fairly high resistance differential galvanometer connected in series, the junction of the two galvanometer coils being also connected with the positive pole of the accumulator under test; if there is no deflection, the internal resistance is equal to that part of the adjustable resistance which is in the second circuit; there is also an error due to polarization. Another method is shown in the adjoining Fig. 1, in which *r* is the accumulator under test, the other is the auxiliary one; *a* is a resistance, high enough that the resistance of the auxiliary cell may be neglected; *b* is a resistance generally larger

than *a*, and should be adjustable; *c* should be capable of carrying the large current. Resistance *b* is adjusted until there is no deflection on the galvanometer when the switch in its circuit is closed; the internal resistance is then equal to $a \times c \div b$; but the effect of polarization is not eliminated. If, however, this method is used like Mance's, the effect of polarization can be eliminated; in this case *b* must be adjusted until the deflection is the same whether the switch *S* is open or closed "if there were no polarization;" polarization will cause a current in the galvanometer in a downward direction; then diminish *b* until a kick in the opposite direction is produced, it being followed immediately by a movement in the reverse direction; then

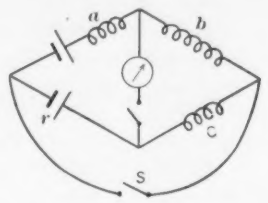


FIG. 1.

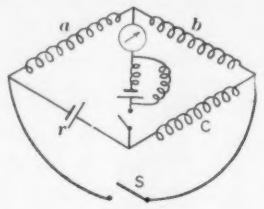


FIG. 2.

increase *b* gradually until this kick on closing the switch just disappears; the value of *b* will then be the correct one to use in the above formula. This method will be found greatly superior to Mance's in the ease of working, as the galvanometer is used near its real zero point; the resistance *c* should preferably be non-inductively wound. Another modification which it is thought will probably work about as well is shown in Fig. 2. The shunt *e* of the auxiliary cell is to be adjusted until the deflection in the galvanometer is practically zero when the switch is open; the resistance *d* is added to increase the internal resistance so as to enable the apparent e. m. f. to be diminished easily without using a shunt of very low resistance. The same formula applies.—Some corrections in the diagrams are noticed in the subsequent issue of Oct. 27; the figures here reproduced are corrected.—Lond. *Elec. Rev.*, Oct. 20.

Measuring Small Self-Induction.—BLONDEL.—A long illustrated abstract of a paper read before the French Society for the Advancement of Science, describing a method based upon the following property of a tortion electrodynamometer. If in the fixed and movable coil there are alternating currents of similar wave form, but differing in phase by 90°, the torque will be zero. He uses two exactly similar rectangular coils, one in series with the self-induction to be measured, and the other in series with an adjustable standard of self-induction; in both coils there are two e. m. fs. differing in phase by 90° furnished, for instance, by a two-phase alternator. The standard self-induction is adjusted for zero torque when thus connected, and again when the self-induction to be measured is short circuited; if the ohmic resistances of the standard, the coil to be measured, and the dynamometer coils are known, the unknown self-induction can easily be calculated. A modified method is to use an adjustable ohmic resistance in the place of a standard self-induction, as the deflection can be made zero in this case also, because the two time constants are made equal to each other.—*L'Eclairage Elec.*, Oct. 28.

The Error of Dynamic Wattmeters.—BLONDEL.—An abstract of a paper read before the French Society for Advancement of Science. He discusses the errors in the readings of wattmeters, resulting from the self-induction of the voltage coil, and shows how to eliminate them, after having determined the self-inductance of this coil. If the difference of phase in this coil is *d*, then the correct power is found by multiplying the readings of the wattmeter with 1-tan *d* tan Ø, in which Ø is the difference of phase in the circuit the power of which is to be measured. (Owing to the self-inductance of the voltage coil, it is not the true power which is measured, but its product with 1 + tan *d* tan Ø; the true power can be found as described only when tan *d* tan Ø is so small that its square can be neglected. See also the abstract on power factors in wattmeters in the Digest this week.)—*L'Eclairage Elec.*, Oct. 28.

Power Factor in Wattmeters.—E. H.—An article referring to the proposal of Benischke (Digest, under Installations, July 22) to make the consumer pay for a proper percentage of the wattless current. The method by which this is accomplished is exactly the reverse of the method of Blondel described in his paper on errors in wattmeters, abstracted in the Digest this week. Benischke gives to the voltage coil of a wattmeter a certain self-inductance so that there is a difference of phase; then the reading of the wattmeter indicates more than the true power, as a certain part of the wattless power is also measured by the meter. Benischke proposed, as an example, to make the self-inductance of the voltage coil so that tan *d* = 0.05. Then the meter measures the power multiplied by 1 + 0.05 tan Ø, that is, the smaller the power factor (cos Ø) in the circuit of the consumer, the larger is tan Ø and the larger is the percentage of wattless power charged to the consumer. If the power factors are 1.00, 0.95, 0.9, 0.8, 0.7, 0.6, then the wattmeter measures 1.00, 1.016, 1.025, 1.0375, 1.05, 1.0665 times the true power, respectively. The present writer remarks that it would be interesting to learn how large the self-inductance of the voltage coil is in the usual wattmeters, that is, whether the unavoidable self-inductance of this coil corresponds to a value of tan *d*, which is larger or smaller than the value 0.05 assumed in this example. If smaller, it would be easy to increase it by using more turns, which would make the apparatus more sensitive.—*L'Ind. Elec.*, Oct. 25.

REFERENCES.

Measurement of Self-Induction.—PATTERSON.—A comparison of Rayleigh's modification of Maxwell's method, with Oberbeck's method, in which the coil of unknown self-induction and known resistance form one branch of a Wheatstone bridge, the coil of an electrodynamometer takes the place of the galvanometer, and a "zinc inductor" that of the battery. The special advantages of both methods are explained.—*Wied. Ann.*, No. 9; abstracted in Lond. *Elec.*, Oct. 20.

An abstract of this article, including the second theoretical part of the original, in which he calculates analytically the self-potential of coils, is given in the *Elek. Zeit.*, Oct. 26.

Laboratory Apparatus for Generating High Voltages.—STRASSER.—A long, illustrated French abstract of the German article noticed in the Digest Aug. 5.—*L'Eclairage Elec.*, Oct. 21.

Storage Battery of 10,000 Volts.—FEUSSNER.—A long, illustrated French abstract of the German paper noticed in the Digest Sept. 23.—*L'Eclairage Elec.*, Oct. 28.

Photometer for Incandescent Lamps.—ROWLAND.—An illustrated paper, describing the convenient form of the portable photometer made by the Electric Motor & Equipment Co.—*Jour. Frank. Inst.*, November.

Contact Device for Taking Alternating Current Curves.—PEUKERT.—An illustrated French abstract of the German article noticed in the Digest Sept. 23.—*L'Eclairage Elec.*, Oct. 21.

Ruhmkorff Coil With Wehnelt Interrupter.—An illustrated description of a practical apparatus, comprising a coil and a Wehnelt interrupter. The apparatus is to be connected with 110-volt mains and transforms a current of 1.6 amp into one of 30 amp.—*La Nature*, Oct. 28.

Wehnelt and Caldwell Interrupters.—LAMOTTE.—The first part of an illustrated article giving brief accounts of a number of researches of different investigators, which have been duly referred to in the Digest.—*L'Eclairage Elec.*, Oct. 14.

Wehnelt Interrupter.—VOLLER and WALTER.—A long illustrated abstract of the paper noticed in the Digest Aug. 19.—Lond. *Elec. Rev.*, Oct. 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cables.—EMERSON.—An illustrated article pointing out the necessity of a Pacific cable. The four proposed cables are described and discussed in detail. The British cable from Vancouver, B. C., to New Zealand, 7152 nautical miles; the American route from San Francisco to the Philippine Islands via Hawaii, 6640 nautical miles; an international "great circle route," following the north Pacific coast, running through Dutch Harbor in Alaska, touching Attu, the last of the Aleutian Islands, crossing in short links to the Russian-Japanese boundary, with one branch to connect with the existing Siberian network of land lines and the other branch to run down through Japan and to the Philippines, 5040 nautical miles, and an overland route via the Yukon River. The third route is thought to be the best.—*Eng. Mag.*, November.

Wireless Telegraphy on Mont Blanc.—J. and L. LECARME.—An account of experiments made with wireless telegraphy during ten days between Chamonix and the Vallot Observatory on Mont Blanc; the straight distance was 7.5 miles and the difference in height 2 miles. After a description of the transmitting and receiving stations, they sum up their results as follows: The experiments were made every day during 11 hours. The signals were satisfactory only for a distance between the oscillator spheres equal to 0.8 inch. The absence of water in liquid form did not interfere, neither did the intervention of clouds. Although atmospheric electricity actuated the apparatus several times, it did not make communication impossible. While the

arc lights in Chamonix were running it was found impossible to send messages; the lighting current was a three-phase current at 2500 volts. It is suggested that as this lighting circuit was closed and therefore involved no spark gap, it may be possible to send wireless telegraph messages by other means than those used by Marconi.—*La Nature,* Oct. 28.

REFERENCES.

Telephone Exchange in Brooklyn.—A brief illustrated description of the large common battery exchange just being completed.—*Elec. Rev.,* Nov. 1.

MISCELLANEOUS.

Institute Standardization Rules.—GUILBERT.—A criticism, followed in another part of that paper by a complete translation, of the recent A. I. E. E. report. The report, as a whole, and many parts of it, are praised, and it is recommended that similar work be done by a French Committee. The unfavorable criticisms are directed chiefly toward the method of testing. The term rotary converter is thought to be insufficient; the classification of converters given by Blondei in 1894 is thought to be very satisfactory. The classification of machines is not thought to be judicious and does not include unipolar machines, certain classes of alternating current motors, etc.; a certain classification into four groups is suggested as preferable. Measuring the efficiency by determining the losses is indorsed, but it is thought that the losses by bearing friction should not be neglected; this is discussed at some length. The methods of measurements are said to be incomplete; to measure the losses more exactly he describes a method which he has used; it consists essentially of running the machine as a motor and determining the curve of the losses at no load as a function of the voltage at the terminals, for a constant speed; this is continued for lower voltages than the normal so that it is possible to prolong the curve to the power axis, which gives the losses by friction and ventilation under the supposition that these losses are constant with the speed. The method for determining the losses due to the charge are thought to be quite impracticable for machines having a collector, whether synchronous or not, and specially when metallic brushes are used. It is not thought proper to determine the efficiency of alternators with non-inductive loads; it is preferable to take the normal conditions and give the power factor. Certain coefficients in the report correspond to a power factor of unity and to a sinusoidal variation of the flux; the latter is not admissible, as it is never realized. Concerning the determination of the temperature, the method is not absolutely correct; the resistance should first be calculated for zero degrees and then for the temperature above zero. The maximum values for the rise in temperature for the different parts of a machine are thought to be too condensed; micanite, for instance, will stand a lower temperature than paper (inferring that the limits should be different for the two); the same is true of transformers with liquid or air cooling. The use of the words variation and pulsation in connection with the angular velocity of a steam engine, are not considered to be well selected. It is not proper to give the maximum power of an alternator for a non-inductive load; the power factor should always be added. The real power and the maximum current at low voltage are the factors of interest. Two of the appendices are thought to be of doubtful value. The apparent efficiency is of no use, as the power factor is generally given. The use of the new term inductance-factor is questioned. The notations are not criticised.—*L'Eclairage Elec.,* Oct. 21.

The *Zeit. fuer Elek.*, Oct. 22, publishes the first part of a German translation of the report, with some very brief criticisms. In order to distinguish "potential regulators" under stationary inductance apparatus, from the usual voltage regulators, it is thought preferable to call them "variable transformers" (Gr. Veraenderliche Transformen); also to use the same term in connection with the compensating induction and magneto-transformers.

New Books.

INDICE DEL COMERCIO AMERICANO. Directorio Descriptivo Clasificado de Los Miembros de la Asociacion Nacional de Manufactureros de los Estados Unidos. Arreglado Para Conveniencia de los Compradores Extranjeros. Philadelphia: National Association of Manufacturers. 362 pages.

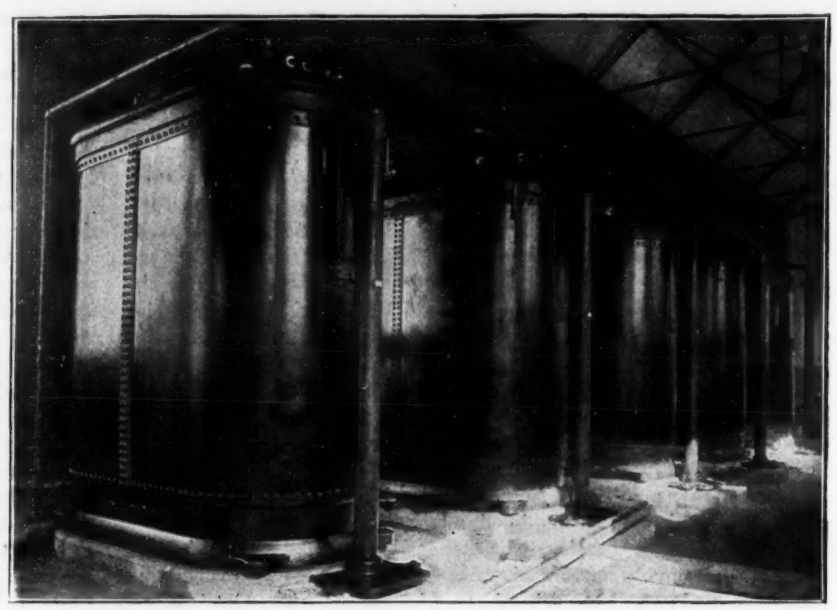
This useful publication of the National Association of Manufacturers of the United States is intended for circulation in Spanish-American countries with the object of extending American export business. Part I. of the book gives the names of the members of the association in alphabetical order, followed by an enumeration of their manufactures. The second part consists of a classification giving the members' names under an alphabetical list of the respective articles manufactured by them.

BOOK RECEIVED.

FOWLER'S MECHANICAL ENGINEERS' POCKET BOOK FOR 1900. Edited by William H. Fowler. Manchester, England: Scientific Publishing Company. 500 pages, numerous illustrations. Price, 1s. 6d.

The Largest Transformers in the World Installed at Niagara.

A contract has recently been closed between the Cataract Company and the Union Carbide Company, both of Niagara Falls, and calls for the former to furnish the latter (on the latter's premises) with 15,000-hp at 2200 volts. It was found that the copper necessary to transmit this amount of energy, at the generator voltage of 2200, would cost several hundred thousand dollars, though the distance is only 2½ miles. It was then decided to use high-tension transmission, and bids were called for from various companies to supply the necessary transformers to transmit the energy at a potential of 11,000 volts. A contract was closed with the General Electric Company to furnish 15,000-hp transformer capacity, which proves to be cheaper than the increased cost of copper necessary to transmit at the low voltage. This fact points to the great advantage of high potential transmission even for short distances.



FIVE 2500-HP TRANSFORMERS AT NIAGARA FALLS.

The General Electric Company are furnishing seven transformers of 2500-hp capacity each, at a frequency of 25 cycles, a primary voltage of 11,000 and a secondary of 2200. These transformers are, it is understood, by far the largest that have ever been built, the next size smaller being only one-half the capacity, namely, 1250-hp. The total weight of each transformer is 50,000 lbs. This is a good load for a freight car, so that a train of seven cars would be necessary for the transportation of the total order. About 12½ tons of sheet iron are used in the cores. The coils of the transformers are 6½ feet long by 4 feet wide, or about the dimensions of the top of an ordinary billiard table.

The clamps for holding the sheet iron core together weigh approximately 4000 lbs., and a steel bar 4½ inches in diameter and nearly 4 feet long is used for a support when raising the apparatus. Even with this large steel bar it is necessary to use a space block that will keep a sling in such a position that the strain will come on the bar near the points of support.

The complete transformer is 11 feet 1¼ inches high, 8 feet 7½ inches wide and 4 feet 4½ inches deep. It cannot be shipped entirely

assembled, as the height is too great to pass under railway bridges. Tests of these transformers give the following results:

Iron loss	22,600	watts.
Copper loss	8,700	watts.
Regulation	½	per cent.
Efficiency, full load	98.3	per cent.
Efficiency, three-quarter load	98.0	per cent.
Efficiency, one-half load	97.3	per cent.
Efficiency, one-quarter load	95.3	per cent.

Rise in temperature after 8 hours at full load is 45° C.

The transformers will run at full speed continuously, so that the copper loss was favored rather than core loss. They are cooled by use of both water and oil, 650 feet of piping being necessary for each. At an efficiency of 98.3 per cent. it would seem at first sight that the radiation of heat due to the losses would be a small matter. But 1.7 per cent. of 2500-hp amounts to over 40-hp, or enough energy to supply 600 16-cp incandescent lamps. The accompanying illustration shows five of the transformers which are already installed.

New Electric "Columbia" Omnibus.

The work in the perfection of automobile omnibuses is by no means confined to Europe, although a great variety of types have already been tried there with more or less success, in cities as widely apart as London, Paris and Berlin. In this country, excellent work is now being done, almost entirely if not wholly, on electrical lines, the demand for such vehicles being large and insistent. We are now able to present a picture of the handsome Columbia omnibus, which the Electric Vehicle Company has had under very satisfactory test for some time past at Hartford, Conn., where its main factories are situated. This 'bus will carry as many as 14 passengers, and has taken that number with ease over 35 miles of the rough roads and hills outside Hartford. It weighs 4500 pounds, inclusive of the battery, furnished by the Electric Storage Battery Company. It is fitted with one motor, and can make a maximum speed of 10 miles an hour, while the controller allows of three speeds forward and three to the rear. Special attention has been given to braking, and it will be seen to be liberally equipped in this respect. Of neat outward appearance, the omnibus is also tastefully fitted up inside and is upholstered in brown morocco. It will carry baggage as well as passengers and the roof has a baggage railing. The wheels are fitted with solid tires. The party occupying the omnibus comprises several members of the German party of electrical engineers and capitalists recently visiting this country, Messrs. Loewe, Noot and Kockerthaler, and Mr. Hart O. Berg, Paris, manager for the Columbia & Electric Vehicle Co., is driving it.

At the side of the 'bus, Mr. Percy Maxim is running a small gasoline Columbia automobile.

COLUMBIA ELECTRIC OMNIBUS.

Testing of a Sectional Third Rail System.

Tests were made last week on a short section of the Consolidated line at New Britain, of the McElroy-Grunow sectional third rail system.

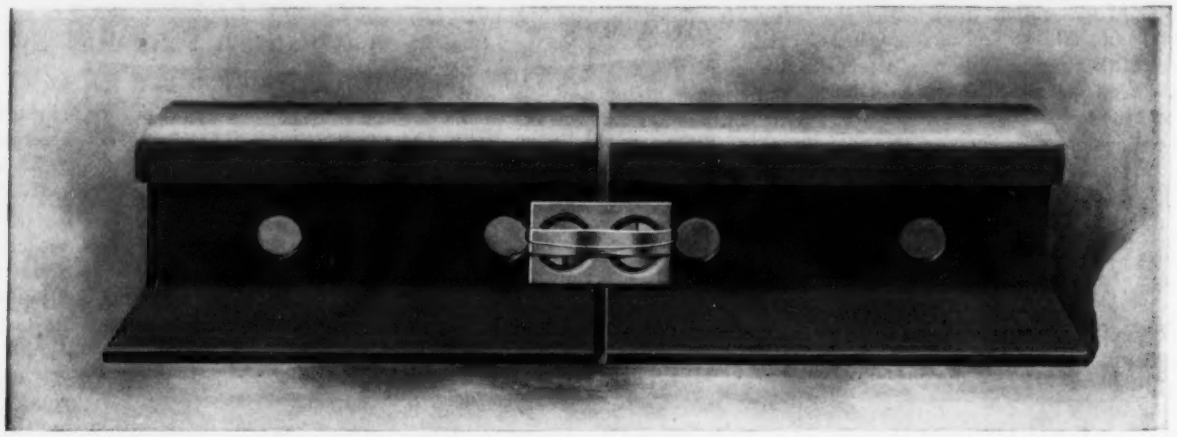
This system comprises a third rail, divided into sections, which may be of any desired length. Each section is connected to an electromagnetic circuit closer. These circuit closers each automatically charge their respective third rail sections as the motor car or train enters upon them, and the sections are again "deadened" and rendered harmless in succession, as the train leaves and passes from them. The current handled ranged from 150 to 1000 amperes at 550 volts, while the test was in progress. Contact is made by a sliding shoe. The system has been elaborated by Wm. Grunow, Jr., of Bridgeport, and J. N. McElroy, of the firm of Macartney, McElroy Co., Ltd., of New York, London and Glasgow.

A New Solid Copper Bond.

In the accompanying illustration is shown a new type of rail bond designed by Harold P. Brown. The bond is made of a rectangular piece of rolled copper, 3 inches long, ⅛-inch thick (or thicker), and 1½ inches or more deep. A cup-shaped projection is pressed near each end so as to give a contact against the rail web close to the end of each rail. Inside the cups is a piece of sheet steel supporting a pair of special steel springs, steel being used to keep the springs from wearing into the copper. These pieces are held together by a small

iron strap until the bond is applied, when the sharp web on the outside of the spring cuts it away; it then enters the angle plate, thus adding to the conductivity of the bond.

The entire bond is amalgamated to prevent rusting, and the contact surfaces are covered with plastic alloy. The springs are proportioned to give a pressure of 1000 pounds per square inch when the angle plate is bolted on. When in service, the springs serve merely as distance pieces so long as the joint is tight, and if the nuts loosen or the plate wears the springs still hold the bond in firm contact. Tightening the track nuts also tightens the bond.



NEW TYPE OF RAIL BOND.

In applying the bond the web of the rail is brightened with the usual hand-power grinder or emery wheel. The surface is then amalagmated and covered with a thin layer of plastic alloy, which latter unites with the amalgamation of the bond and gives an electrical contact of low resistance which does not rust. It is stated that the lubrication afforded by the plastic bond permits the rails to move in any direction without wearing away the metal of the bond.

Lea Enclosed Arc Lamp.

The enclosed arc lamps shown in the accompanying illustrations are made by the Lea Manufacturing Company, Elmwood, Ind., Fig. 1 showing the direct current lamp, Fig. 2 the mechanism of the alternating current lamp and Fig. 3 a general view of one of the lamps.

These lamps have recently been improved both in the internal mechanism and in the design and finish of the covers. In both alternating and direct current lamps a hinged cover is used, which can be opened with one hand, and which has no loose parts to hold or let fall. The dash pots are all made of fiber graphite, as experience has shown it much better suited for this purpose than brass or nickel, since it is not affected by heat, is self lubricating, does not wear loose and will not stick. A relief valve is placed in the top of the dash pot, allowing it to drop quickly when feeding.

The closed bottom inner and outer globes have been adopted for all types, being less liable to break, making trimming much easier, and adding greatly to the life of the carbons. No gaskets are used, the inner globe being pressed against a ground joint at the top by a phosphor bronze spring, thus insuring freedom from air leaks.

The alternating lamp is made much on the same lines as the direct current lamp, and is identical in outward appearance and size. It is as near noiseless in its operation as is possible to make a lamp using alternating currents, gives nearly the same life as the direct current lamp, and, being provided with adjustable reactance, the same lamp can be used on both 7200 and 16,000 alternations by changing one connection. As usually adjusted the lamp consumes 425 to 450 watts, and gives a clear white light.

Among the newer types of the Lea lamp are a marine lamp, shade lamp and a "Baby" lamp. The latter is only sixteen inches long, burns from 50 to 60 hours, and is adjusted to 2½ amperes on 110 volts. It is finished in polished brass only, and is intended for interior use.

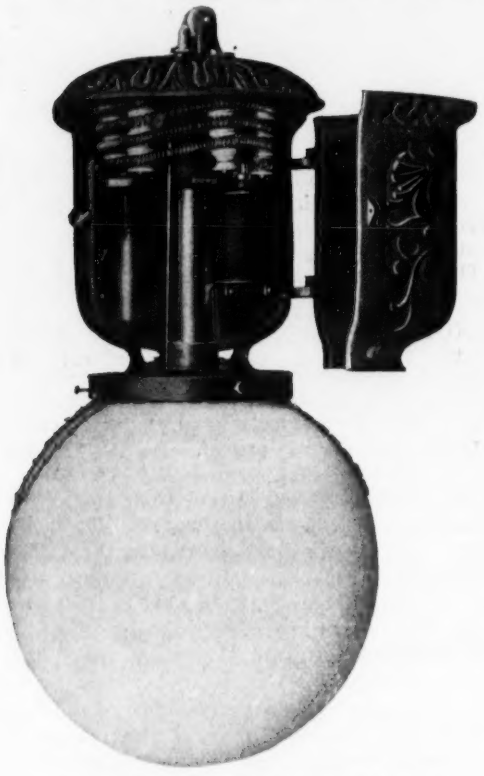


FIG. 1.—DIRECT CURRENT LAMP.

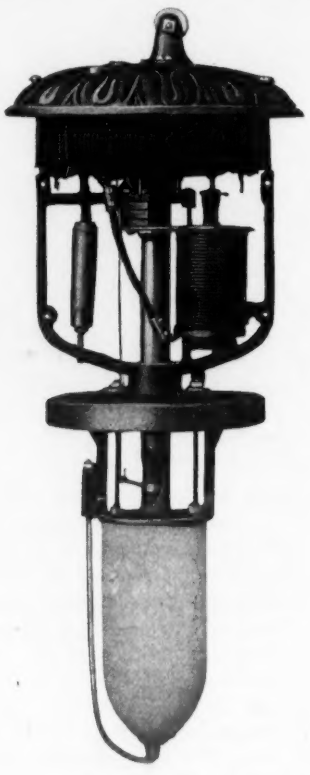


FIG. 2.—ALTERNATING LAMP.

FIG. 3.—GENERAL VIEW OF LAMP.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was marked on the whole by a gradual decline in values, although in view of the low bank reserves and the demand for money in trade, it cannot be said that there is any real weakness except in some of the absurdly inflated industrials, which are worked up and down on the least provocation. Railroad stocks and other investment properties remain strong. During the week 2970 shares of Western Union were dealt in, going off 1¼ to 88¼. Rumor is still rife with future Western Union deals in the telephone field, but at present such talk does not increase the company's income. General Electric went up 1 to 123 on sales of 2600 shares. Brooklyn Rapid Transit went off 2¼ to 86 on 200,730 shares, and Manhattan Elevated, after the discouraging annual report, dropped 8½ to 102, on dealing in 181,471 shares. Metropolitan Street Railway on 23,693 shares also went off 4¼ to 192¾. In Boston American Bell Telephone is beginning to show the effects of the new "opposition" more, and declined to 351@353, a decline of 15 points for the week. Other closing telephone quotations were: Erie, 107½-108½; Michigan, 100-105; New England, 151-153; Mexican, 3. Boston Elevated was quoted at 106; West End, 93-93½. In Chicago, elevated and traction stocks closed the week rather dull. South Side was quoted at 100, Lake Street, 16; Metropolitan, 23; preferred, 70¼; West Chicago, 117¼; Union Traction, 28; preferred 80¼; Chicago Edison, 174. In Philadelphia, Electric Storage Battery was quoted 120-122, preferred, 124-126; Penn. Elec. Vehicle, 7-7⅛, preferred 4-4⅛; Phila. Traction, 95¾; Union Traction, 38⅜; Consol. Traction, N. J., 63⅞; Gen. Elec. Automobile, 6; Electric Co. of America, 13¾-14; American Railways, 4½-5. In the New York outside market, Electric Axle Light & Power showed marked signs of upward tendency, and closed at 4¾-5¼. Electric Vehicle remains weak and was quoted 72 common and 95 pref.; N. Y. Elec. Veh. Transportation, 13¼-14; New England, 7-7⅛; Illinois, 3¾-4¼; Electric Boat, 24 common and 41 pref.; General Carriage, 34; General Electric Automobile, 16-24; Nat. Gramophone, 74-80; Otis Elevator, 28½-30 common, 91-93 pref.; N. Y. & N. J. Telephone, 191-205.

MANHATTAN ELEVATED.—Stockholders in the Manhattan Railway Company held their annual meeting early in the week. There was disappointment, over the failure of the stockholders to elect representatives of the Vanderbilt and Whitney contingents to the board, predictions of such developments having been in circulation for a month and longer. This disappointment led to free selling of Manhattan stock for both accounts that resulted in a decline from 111⅜ to 107½. The unfavorable figures of the annual report, which showed a deficit of $238,360, against a surplus of $48,103 last year, were also a bearish influence on the stock, although these had been pretty well discounted. The annual report of the company for the fiscal year ended September 30 shows, as compared with the previous year:

	1899.	1898.		Changes.
Gross earn.....	$9,325,111	$9,204,466	Inc..	$120,645
Op. ex. and tax.....	6,113,790	6,066,682	Inc..	47,108
Net earn.....	$3,211,321	$3,137,784	Inc..	$73,537
Int. on bonds.....	1,889,681	1,889,681		
Balance	$1,321,640	$1,248,103	Inc..	$73,537
Dividends	1,560,000	1,200,000	Inc..	360,000
Deficit	$238,360	sur. $48,103	Inc..	$286,463
Prev. sur.....	4,401,207	4,353,104	Inc..	48,103
Total sur.....	$4,162,847	$4,401,207	Dec..	$238,360
Pass. car.....	177,204,558	179,728,356	Dec..	2,523,798
Op. exp. exc. tax.....	56.69	57.70	Dec..	1.01
Op. exp. inc. tax.....	65.56	65.91	Dec..	0.35

In 1899 the company paid 2 per cent. dividends on $30,000,000 capital stock and 2 per cent. on $48,000,000 stock, against 4 per cent. and $30,000,000 stock in 1898.

ERIE TELEPHONE BONDS.—H. W. Poor & Co., of New York and Boston, offered this week at 101 and accrued interest $1,000,000 Erie Telegraph & Telephone Co. debenture 5 per cent. gold bonds. The company, through ownership of stock, controls the Northwestern, Southwestern, Cleveland, Michigan and Wisconsin Telephone Companies, including the City of Cleveland, making this the largest organization under the Bell Company in the country. The proceeds from the sale of the bonds now offered will provide for the recent acquisition of the Wisconsin Telephone Company, and for the purchase of stock in the Cleveland, Northwestern, Southwestern and Wisconsin Companies. The Erie system has paid 63 quarterly dividends at the rate of 4 per cent. per annum and the last dividend puts the rate up to 5 per cent. The system now includes 95,090 subscribers, a gain of 32,297 in nine months, and the company has spent nearly $2,500,000 in the last six months trying to catch up with its new business. Based on ownership of stock in constituent companies, the Erie shows for 1899 gross income of $755,000, expenses $420,000 and dividends of $212,500, leaving surplus of $123,000. The real estate of the constituent companies is placed at $1,200,000.

ELECTRIC LIGHTING BONDS.—The $20,000 5 per cent. 20-year light bonds of St. Augustine, Fla., have been awarded to the First National Bank of St. Augustine at 105. Monroe, Mich., has awarded to the Commercial National Bank of Detroit the contract for the municipal electric lighting bonds for $20,325 by the council. The bond issued is for $20,000. The 5 per cent. 6-15-year serial electric light bonds of St. Louis, Mo., amounting to $10,000, have been awarded to Feder, Holzman & Co., of Cincinnati, at 105.25. The 3½ per cent. 20-year courthouse and power station bonds for Allen County, Ind., amounting to $200,000, were awarded to N. W. Harris & Co., of Chicago, at 102.77. The $10,000 14½-year average light bonds have been awarded by the authorities of Greenport, L. I., to the Southold Savings Bank, Southold, as 3.10 per cent. bonds, at par.

GENERAL ELECTRIC.—One of the stocks which acts strong is General Electric. While sales are moderate, says the *Wall Street Journal*, the buying is of the best character. There are rumors that there may be an increase in the capital stock of the company within the near future. It will be remembered that the capitalization was decreased recently, but this was purely on account of the cumulative dividends on the preferred stock which could not be arranged for in any other convenient way. It is now said that the increase in the company's business has been such that a stock dividend could be paid out of accrued profits or that additional facilities for manufacturing apparatus could be profitably acquired.

THE MANHATTAN RAILWAY COMPANY has turned to immediate good use a very considerable part of the $18,000,000 received on the new issue of stock. Officials admit that the company has been placing the money with a well-known trust company, which has been lending it on the street and averaging more than 8 per cent. It is said that more than $10,000,000 were thus put out, and that the amount realized is more than three times the total of the dividends on the new stock since it was issued. The earnings of the company are officially said to be very gratifying, and regularly increasing.

THOMSON-HOUSTON—At a meeting of shareholders of the Thomson-Houston Trust Securities, Series "D," it was voted to continue the trust for ten years, under control of the same trustees. Series "D" was established October 5, 1889, to run ten years, with an issue of stocks and bonds to the amount of $2,416,468 in the form of a Thomson-Houston dividend upon 120,000 shares. Upon this trust there has been paid $1,549,200, or $12.91 per share. The face value of the securities still in trust is $382,336, but their real value is very problematical. The expense of administering the trust has been $40,726.

AUTOMOBILE STAGES IN NEW YORK.—The Fifth Avenue stage line, it was reported in Wall Street this week, but not confirmed, has passed into the formal control of the New York Electric Vehicle Transportation Co. The stock of the Fifth Avenue Co. was purchased some time since by William C. Whitney, and it was said at the time that Mr. Whitney had bought the stock with the intention of turning it over to the New York Electric Vehicle Transportation Company, a subsidiary company of the Electric Vehicle Company, which is controlled by Whitney interests.

WESTERN ELECTRIC.—The Western Electric Co., which is erecting a new building at West, Bank and Bethune streets, New York City, has mortgaged that property to the Bank for Savings for $625,000. The mortgage is due in three years, and the interest rate is 4 per cent. The extension to the big factory is imperatively required by the work on hand. It is not long since the company increased its capital stock by $1,500,000 to provide means for meeting the business rolling in upon it.

BROOKLYN RAPID TRANSIT EARNINGS.—The statement of the October earnings of the Brooklyn Rapid Transit system, including the Kings County Elevated, shows total earnings of $975,000, made up of $948,000 from passengers and $27,000 from other sources. In 1898 the total earnings for the month were $932,000, and in 1897 they were $828,000. Since July 1 the earn-

ings of the system have amounted to $3,837,000, as against $3,765,000 in 1898 and $3,297,000 in 1897.

MASSACHUSETTS ELECTRIC COMPANIES.—The income of all the street railway companies, which comprise the Massachusetts Electric Companies, and which were operated in October, 1898 and 1899, compares as follows: October gross—1899, $363,644; 1898, $344,907; increase, $18,756; increase, per cent., 5.43. Income of all the companies for October, 1899, was $367,828, against $344,907 for October, 1898.

BOSTON ELEVATED.—Although no official action has yet been taken, it is understood that the Boston Elevated Railway Co. will shortly begin to call, in instalments, the balance of its capital, $50 per share. Possibly $10 per share will be called in January, and $10 a share every month thereafter until the entire $50 a share is paid.

WAR TAX COMPLAINT.—While there has been no trouble in regard to the stamp tax on checks, there has been much complaint on the part of bankers about paying the 4 cents per $100 for cable-despatch remittances, since they are charged only 2 cents on foreign checks of any amount. There will be an effort to remedy this inequality.

NATIONAL GRAMOPHONE securities showed considerable strength in the outside market last week and advanced from 77 to about 80 on moderate transactions. The advance in this stock was credited to the fact that the earnings of the company are very satisfactory, and are being substantially used in the way of monthly dividends on the stock.

COMMERCIAL CABLE.—Stockholders of the Commercial Cable Co. are to vote December 4 on a proposition to increase the capital stock of the company by $5,000,000.

Commercial Intelligence.

THE WEEK IN TRADE has been marked by satisfactory conditions, and the outlook is excellent for sustained activity. In the eicctrical field a very good demand is reported in lighting accessories and a large amount of special work is being taken on for the Christmas trade, it being evident from the orders and inquiries that the stores expect the biggest kind of business as a result of the general prosperity. All the factories are busy without exception, the only complaint being that of slow deliveries of raw material. In the telephone line of trade considerable interest is manifested in the talk about new opposition with money behind it. There is a realizing sense of the fact that if an opposition to the Bell worthy the name is to be knit together vast sums of money must be spent on material of all kinds, not only in building new lines and exchanges but in licking lots of the existing ones into decent shape. It is, moreover, a curious thing that among the rumors circulating around the trade are very circumstantial stories to the effect that both the Western Union and Postal Telegraph Companies have been in the market for twin conductor cables, and it is even said that the Western Union is laying one of 30 pairs across the North River. All of which is very interesting. One authority estimates that the new telephone work even now in sight is easily $25,000,000 for next year. As to trade on the whole Bradstreet's says that the strength of prices is a natural outcome of past and present active demand, and is still the leading feature of the trade situation, notwithstanding that unseasonably warm weather in some sections of the country tends to restrict retail distributive trade, and necessarily exercises some effect upon reorders from and collections by jobbers. Less than ordinary interruption, it is noted, is indicated by election day observances. Active demand on railroad account has induced an advance in iron and steel bars of $5 per ton, but steel billets are lower. There is a heavy volume of business reported in pig iron for late 1900 delivery, and that product is slightly higher here in the east. Blast furnace statistics for October point to a further increase in production, but stocks again show a decrease, pointing to consumption still outstripping production. Copper is dull at the recent decline to 17 cents, and tin is rather weaker. The coal trade is experiencing decidedly satisfactory conditions; the output of anthracite for October—4,900,000 tons—is 2.5 per cent. larger than a year ago, and for the ten months shipments are 17 per cent. larger than a year ago. Speaking of the money situation, Dun's says that it does not appear that legitimate trade or productive industry has at any point been seriously embarrassed by lack of money, and a free return of currency from the west may be expected from about this date. Money is coming in from the interior, and lower rates at Chicago and St. Paul indicate a heavier movement near at hand. According to Dun's, failures for the first week of November were $1,331,647, manufacturing $737,645, and trading $545,432. Failures for the week have been 157 in the United States, against 211 last year, and 23 in Canada, against 26 last year.

NEW BIG ENGINES.—Some data was given in this department as to the big new Westinghouse engines ordered by the New York Gas & Electric Light, Heat & Power Co. A recent chat with Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Co., brought out the interesting fact that no fewer than 24 of these large engines have now been ordered for Greater New York, which gives an idea as to the trend towards the liberal production and supply of cheap current in this vicinity. These are the 12 engines for the Third avenue road, the eight for the New York Gas & Electric plant and four for Brooklyn. In the last two cases, the generators are placed centrally in the engine frame; for the New York Gas & Electric plant the engines will have an extended shaft with the generator on the outside. The New York Company's engines are to work at 75 revolutions and 175 pounds steam pressure. The two Brooklyn engines provided are 4500-hp rated, with a regular maximum of 6600-hp and an ultimate ability of 7200-hp. The New York Company's engines, as noted already, will be about 6200-hp, working up to 8000 and able to go to over 9000-hp. Just how much larger engines will get in electrical work is an open question. At present the size of the unit is running up tremendously, but the plant as a whole has just as many units in it as the old style of station had. No one has yet come forward with the plan to put the New York Gas & Electric Company's 50,000-hp into one unit of engine and generator. Why not?

RUBBER AND AUTOMOBILES.—Mr. Charles R. Flint, who is one of the prime owners and promoters of the Rubber-Goods Manufacturing Company of this city, states that he has no interest in the formation of any concern for the manufacture of automobiles. "Numerous rumors," he says, "have been going the rounds that a trust was to be formed, having a capital of $200,000,000, and intended among other things to buy up the interests of the Rubber-Goods Manufacturing Company. These rumors are not entirely groundless. But there was never any possibility of the Rubber-Goods Manufacturing Company going into it. Such reports are nothing more than fairy tales. We would not go into such a combination if we were given a chance. We have been securing control of the rubber-working industries of the country in order to consolidate them under one management. The purchase of the Hartford works completes this deal, which has been brought towards its completion by the recent purchases of the Peoria, Indianapolis, and Indiana Bicycle Companies' plants. They will be conducted hereafter under the management of the Rubber-Goods Manufacturing Company of this city, and will not be merged into the rumored automobile corporation." The Electric Vehicle people, the Riker automobile people and the Woods automobile people all disclaim any idea or intention of entering Mr. Homer Hedge's "combine."

THE PRICE OF COPPER now and in the near future remains a question of deep interest to all electrical manufacturers, who welcome all expert opinion on the subject. An authority on copper says: "There is no reason why a decline in the price of copper even though it were of a pronounced character should affect the prices of other metals except in a general way. Of course, any great decline in one metal causes others to decline to a degree in sympathy. As far as copper is concerned it may be said as long as it remains above 17c. there is no reason for alarm. At this figure it is selling very much higher than it was a year ago when many of the companies were making good profits. There is an impression in some places that the appearance of weakness of the copper situation might tend to exert some influence on the prices of other metals which would naturally be reflected in the securities of some of the companies engaged in this line of business. So far there is no indication that other metals have been affected, although the weaker tone of some of the steel stocks may be partly attributed to this reason. The reported weakness of copper was greatly exaggerated as proved by the fact that the prices of copper in London displayed a much firmer tone on Wednesday and was in a measure shown by improvement in the tone here."

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., has completed a title to ten acres of land. On the premises are to be erected substantial brick buildings to be utilized for the manufacture of the power pumps which the Goulds Manufacturing Company has been engaged in constructing for some years past. The plans for the new buildings have been completed and show a machine shop 258 feet in length by 100 feet in width, boiler house 44x67 feet, a foundry 122 feet in depth by 85 feet in width, and a pattern warehouse 78x30 feet; also coke and sand sheds of suitable dimensions. The buildings will be one-story in height, and supplied with all the latest improved machinery for handling great bodies of iron, and for the manufacture of large triplex pumps for water works, mining and other purposes. The construction of the new buildings will not lessen the manufacturing business at the present works of the company, but will materially add to the facilities for turning out more work. The new buildings will cost from $50,000 to $60,000, and work upon them will be in successful operation in a few days.

MESSRS. MORRIS E. LEEDS & CO., Philadelphia, through their selling agent Mr. James G. Biddle, 1038 Drexel Building, that city, are building conductivity testing outfits for the Boston & Montana Consolidated Copper & Silver Mining Company, and also for Prof. Robb, of Trinity College, Hartford. These equipments are similar to those which Mr. Biddle has supplied to John A. Roebling's Sons Co., Bridgeport Copper Co., Seymour Mfg. Co., Coe Brass Mfg. Co., Waclark Wire Co., Bridgeport Brass Co., Michigan College of Mines, Guggenheim Smelting Co., Pittsburg Reduction Co., Lake Superior Smelting Co. and Stanley Electric Mfg. Co. It is a matter of vital importance to be able to accurately measure the electrical conductivity of copper wire and rod in small lengths. The same also applies to other metals to a certain extent, especially aluminum, which is now being introduced for transmission purposes. It is believed that the special outfit furnished the Pittsburg Reduction Co. is the first one that has been used for tests of this character with aluminum. The apparatus is explained in a pamphlet issued by Mr. Biddle.

EXPORTS OF ELECTRICAL MATERIAL FOR NEW YORK.—The following exports of electrical materials are from the port of New York, for the week ending November 11: Argentine Republic—97 packages electrical material $1374; 22 cases electric motors $1377. British Possession in Africa—2 cases electrical machinery $50. Berlin—7 cases electrical material $4698. British West Indies—2 cases electrical machinery $400. British Honduras—1 case electrical material $26. China—16 cases electrical material $422. Hamburg—39 cases electrical machinery $102; 109 cases electrical material $7928. Hong Kong—5 cases electrical material $111. Havre—31 cases electrical material $3045; 5 cases electrical machinery $181. Japan—15 cases electrical material $2921. London—47 packages electrical machinery $1865. Liverpool—135 packages electrical material $5776. Newfoundland—13 cases electrical material $149. Odessa—22 cases electrical material $840. St. Petersburg—60 packages electrical material $3936. U. S. Colombia—2 cases electrical material $198. Uruguay—4 cases electrical material $245.

TRAIN LIGHTING.—The Electric Axle Light & Power Co., of 100 Broadway, N. Y., has already begun to build up an excellent business with the steam railroads, and most encouraging reports are heard as to its refrigerating system. Among its recent orders are some magnificent dining car equipments for the Delaware & Lackawanna. Mr. Henry E. Fanshawe, general manager, reports inquiries and orders in every direction. The better to keep up with its work the company has now increased its manufacturing facilities by opening additional shops in the old Western Electric building on Greenwich street, where a large amount of interesting work has been turned over to Mr. Montgomery Waddell, consulting engineer, and Mr. Max Loewenthal, electrical engineer. Car lighting and refrigerating bids fair to become a colossal electrical industry, and is to be vigorously pushed.

KERITE FEEDER CABLE FOR HAVANA RAILWAYS.—The largest contract for the export of feeder cable ever placed in this country has been awarded to W. R. Brixley, manufacturer of the Kerite cables. The cable is intended for the Havana Electric Railway Company, in which concern English, French, Belgian, Cuban and American capital is interested. The order calls for 40 miles of rubber-covered feeder cable embracing sizes from 211.000 c. m. to 1.000.000 c. m. The weight of the cable will vary from 2¾ pounds to 5 pounds per foot. The total weight will be in the neighborhood of 5000 tons. The contract calls for shipment between January 1 and February 1, 1900. The value of the contract is $184,000. The first news of this order was given in this department some weeks ago, and the order was taken by Mr. G. F. Porter, New York manager, etc.

THE C & C ELECTRIC CO., of Liberty Street, New York City, have been very busy of late and have made new records for heavy sales. They are doing not only a heavy domestic business, Mr. Campbell Scott says, but a large foreign trade, and the factory is being driven at its highest point of output. A number of small generating sets are being built for U. S. cruisers and transports, and a contract has been received for motors to be used in connection with the heating and ventilating system of Cornell Medical College. A cable order from England calls for 27 motors of 2½ to 35-hp, and orders are in hand for some 15 machines of 2½ to 15-hp each, to be shipped to Buenos Ayres. From Guatemala, South America, an order has been received for an electric lighting plant.

THE SAWYER ELECTRICAL CO., Philadelphia, has a contract for the entire electrical work in the building to be erected by Mr. William Weightman, 1035-37 Market street. They will also install the pumps and other details of the steam plant. They are also now installing the electrical conductors in the "Sherwood," a new apartment house at Thirty-eighth and Ludlow streets. This building is also owned by Mr. Weightman. The Sawyer Company has contracts for the residence of Mr. John C. Bullitt, Welde & Thomas Brewing Co., Jordan L. Mott's Iron Works new store, 1128 Walnut street, and the apartment house, 203 South Twelfth street, all of which work is in progress.

TELEPHONY IN MEXICO.—The decline in Mexican telephone stock is probably due in a measure to the evidence that the Mexican government is going into the telephone business, as it has already gone into the telegraph business. Therefore, instead of the Mexican Telephone Co. securing the right to long distance telephones between the cities of Mexico, as has been hoped for, it may find the government in competition with it in the telephone business. It is reported from Mexico City that G. & O. Braniff have a contract for the construction of telephone lines for the Mexican war department, and that the Electric Railway Equipment Co., of Cincinnati, has the contract for the poles.

MOTOR CARRIAGES IN CANADA.—The Canada Cycle & Motor Company has been formed in Ontario. It embraces the five largest firms in the province, and starts with a capital of $6,000,000. The combined output last season was 38,500 bicycles. An important branch of the business will be the manufacture of motor carriages, for which there is an increasing demand in Canada. Within the last couple of weeks announcement was made of the intention of another large syndicate, the National, coming from the United States, to establish business in the city of Toronto, Ont., to turn out about as large a product as the Canada Cycle & Motor Company.

TELEPHONE MATERIAL.—Some idea of the extent to which the independent telephone movement is going may be formed from the fact that one manufacturer alone, who does not touch work for any of the smaller exchanges, has already equipped within the past year or so exchanges with 14,000 switchboard capacity, and now has orders on hand for large exchanges, although the cities are not among the largest, for over 20,000 switchboard capacity. In other words, his output alone will run about 35,000 switchboard capacity within about two years.

STREET RAILWAY APPARATUS FOR NEW YORK.—The electrical development of the street railway systems in New York would go on a great deal faster if the apparatus could only be secured. The Metropolitan Street Railway Company has just ordered from the General Electric Company about $40,000 of additional equipment, including one 300-kw transformer, and three exciter sets driven by induction motors of 230-hp each. The General Electric Company has already in hand a lot of big Metropolitan orders.

PECKHAM TRUCKS FOR PARIS.—The Peckham Motor Truck & Wheel Company, of Kingston, N. Y., last week shipped 30 motor trucks to Paris for use on the electric roads now being constructed in that city. Twenty-six trucks were also forwarded to England, which are intended for the Halifax Municipal road. The orders were secured through Robert W. Blackwell & Co., Ltd., of London, Liverpool and Paris, which company is represented here by W. W. Borman.

THE STERLING ELECTRIC COMPANY reports a contract with the Century Construction Company, of Cleveland, O., for a 400 number equipment, including switchboard, distributing board and combined terminals and protectors. Attica, Ind., is to have a new telephone exchange plant, the apparatus selected being of the Sterling Electric Company's make—300 numbers of switchboard, distributing board, and combined terminals and protectors being the initial order.

ALUMINUM VS. COPPER.—It has been rumored that the Boston Elevated was substituting aluminum wire in place of copper wire. The Boston Elevated Company, always abreast of the times, some time ago made a test of aluminum, but it was not satisfactory and the company decided to stick to copper.

MR. C. O. MAILLOUX, consulting engineer, American Tract Society Building, New York, has awarded a contract to Woolston & Brew, of 141 Broadway, for two 100-hp Brown engines, direct-connected to Western Electric Company's generators, for the Leggett Building, in Brooklyn.

PLANT APPARATUS WANTED.—The Walkill Valley Electric Light & Power Company, of Walden, N. Y., are in the market for two boilers and other steam apparatus and auxiliaries. Mr. A. J. Fowler, superintendent of the plant, should be addressed.

PLANT WANTED.—Plans, specifications and estimates are invited for a complete electric light and power plant. Particulars can be had by calling on or addressing J. A. Murray, manager, Pontiac, Ill., or S. E. Simms, secretary.

STREET RAILWAY ENGINES.—The Johnstown (Pa.) Street Railway Company has recently placed an order with the Frank A. Pierce Engineering Company, of the Havemeyer Building, for two 750-hp Corliss engines.

Special Correspondence.

NEW YORK NOTES.

New York, Nov. 14, 1899.

PARK AUTOMOBILES.—Mr. Clausen, president of the Park Board of New York City, has tried an automobile in Central Park and has now issued a permit to Mr. R. A. C. Smith, who owns a Columbia electric.

MR. ALEX. LIVINGSTON, Jr., has assumed the general managership of the Varley Duplex Magnet Company, 138 Seventh Street, Jersey City, N. J. This company has recently built large additions to its plant to meet the growing demands of the business.

MR. W. W. BURNHAM, former manager of the Electric Gas Lighting Company, Boston, Mass., with which concern he was connected for 15 years, is now associated with the firm of Stanley & Patterson, of this city. Mr. Burnham will take charge of the correspondence, etc., and no doubt his experience and reputation will result beneficially to the firm.

THE BROKERS' DISTRICT TELEGRAPH COMPANY, of New York City, was incorporated at Albany on Nov. 2, with a capital of $10,000, to supply messengers for the purpose of delivering messages and other property and to deliver messages by telegraph or telephone. The directors are Samuel M. Richardson and George H. Vandewalker, of New York City, and Henry D. Kuck, of Tompkinsville.

TROLLEY MAIL CARS IN BROOKLYN.—An agreement has been reached between President Rossiter, of the Brooklyn Rapid Transit Company, and Postmaster Wilson, of Brooklyn, as to the compensation to be paid the transit company for running mail cars over the road. The previous contract price was 12 cents per mile. A compromise was effected at 10¼ cents. The contract will have to be submitted to the Post Office Department at Washington for approval.

ELEVATED ELECTRIC CAR BURNED.—An electric motor car was destroyed by fire on the Brooklyn Elevated Railroad a few days ago. The passengers sought safety in the rear cars. Firemen soon had several streams playing on the burning car, and the flames were extinguished in 15 minutes. The fire delayed traffic on the elevated road for three-quarters of an hour, and trains were stalled on both tracks. It is thought that the fire was due to defective insulation in the heating apparatus.

A PRINTING EXPOSITION is promised next May at the Grand Central Palace, under the auspices of and for the benefit of the charities of Typographical Union No. 6. Mr. Marcus Nathan is the general manager, and he is already hard at work. The outlook is very bright for a big show, in which electricity will be quite conspicuous. The literature of the show now being issued is very pretty and effective. Mr. Nathan speaks with absolute confidence of the success of the show.

WETMORE & LANDSING have opened an office at 120 Liberty Street, New York, as special machine designers and consulting engineers. Mr. Jang Landsing is well and widely known to mechanics through his many original contributions to the *American Machinist* as well as for his long identification with the Brush Electric Manufacturing Company, of Cleveland, Ohio, as their machine designer, and for his late responsible services to the E. W. Bliss Company, of Brooklyn, N. Y. Mr. Jean A. Wetmore is a well known member of the electrical fraternity in the United States.

THE NEXT AUTOMOBILE SHOW.—At the cycle and automobile show to be held at Madison Square Garden during the week following Jan. 20, a full line of motor vehicles will be shown. Already a large number of makers have applied for space, and the indication is that the fifth annual exhibition will surpass all others. The big amphitheatre will be divided into 143 spaces on the main floor, devoted exclusively to bicycles and automobiles, with 81 additional spaces on the first balcony. Space will be allotted according to the order of application, and will be limited to those products that will be of interest to the motor-vehicle trade. Makers of parts which are used in the construction of horseless carriages will be largely represented. It will be under the management of Frank W. Sanger, well-known to participants in the electrical exhibitions there.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company, was elected on Nov. 13 to succeed A. A. McLeod as president of the American Air Power Company. The air power company has a capital stock of $7,000,000, and is controlled by the syndicate which owns a majority of the stock of the Metropolitan Company. It controls the compressed air motor patents for street railways. The New York Autotruck Company, in which Richard Croker is interested, has the right to use the same patents for trucks. There were rumors in September that the railway company was not satisfied with the operation of the motor which is now in use on its Twenty-eighth and Twenty-ninth Street crosstown lines. At that time the stock declined sharply, but it has since recovered its loss. The election of Mr. Vreeland yesterday was looked upon as indicating that the motor has proved satisfactory. At the same time there are persistent reports that storage battery cars are being built for the road.

RAPID TRANSIT FOR NEW YORK.—The Rapid Transit Commissioners are to advertise for bidders for the underground electric system, bids to be opened Jan. 15. The contractor's bond has been reduced to $5,000,000, with a cash payment as guarantee of $1,000,000. While building the road, for which five years is allowed, he must pay the interest on the bonds issued by the city to furnish him the money for the work, and in addition 1 per cent. annually on the amount of these bonds to form a sinking fund, which, it is calculated, will entirely redeem the issue at the end of the 50 years for which he is to operate the completed road. Besides this, he is to pay the city a certain percentage of all his gross earnings above $5,000,000 yearly, the size of this percentage and the sum for which he undertakes to build the road both being the subjects for the competitive bidding. After completing the road the contractor must furnish an additional bond of $1,000,000 to insure his paying the city's proportion of the gross earnings. At the same time his cash guarantee of $1,000,000 and his original bond of $5,000,000 will be released. The contractor must bid for the entire contract, bidding by sections, of which there are four, and must build by sections, beginning at the southerly terminal.

AUTOMOBILES IN CENTRAL PARK.—The question of permitting automobiles to run in Central Park came up before the park commissioners during the week for argument. For two hours arguments were presented for and against the proposition, and the proceedings were not devoid of good-natured merriment. The speakers in favor of admission contended that the vehicles were not dangerous nor provocative of fright in horses, while those against claimed that they would frighten horses. Among those who spoke for admission was Mr. A. L. Riker. A. R. Shattuck declared that he had recently traveled a thousand miles in an automobile, meeting horses of all descriptions, without causing a runaway. In Paris, where automobiles are encountered everywhere, he insisted there was immunity from runaways due to their presence. The French plan, however, of examining and licensing automobile drivers, he believed should be adopted here. The arguments of the opponents seemed to be based on the fear that horses might become frightened at horseless carriages, and run away. Counsel for the Central Park Hackmen's Association argued against the automobile on the ground of danger and the fact that the machine was in an experimental stage. While referring to breakdowns, he was asked by a gentleman on the other side if he ever heard of a horse breaking down. "Yes, but I never heard of one blowing up," was the reply. The commissioners will consider the matter and render a decision soon.

NEW ENGLAND NOTES.

Boston, Mass., Nov. 11, 1899.

CENTRAL MANUFACTURING COMPANY, 10 Central Street, Boston, Mass., have been appointed New England representatives for the Keystone Electric Company, Erie, Pa. Mr. J. A. Desmond, formerly with the Fort Wayne Electric Company, and Mr. A. G. Dyar will have charge of the above territory.

DAMAGE TO A POWER HOUSE.—The side of the power house at Bolton Falls, Vt., which was recently partly destroyed, has been completely carried away. The underpinning on one side has been entirely washed out and the building wrenched away from its fastenings to the stone dam on the end. The workmen expect any moment to see the power house topple over into the stream and be swept down the river.

THE FRANKLIN FUND left to the City of Boston in 1791 by Benjamin Franklin to be used for the benefit of young tradesmen and mechanics, at the end of 100 years, is at last to be expended. The original bequest of £1000 sterling now amounts to about $400,000. It is announced that one-half the fund will be used for the erection of a public building in the south end to be known as the Franklin Building, with a hall for public meetings and various lecture rooms in which a course of lectures on trade subjects will be carried on. The other half will be spent for public baths and gymnasiums.

THE BERLINER PATENT CASE.—An important issue is involved in the suits of the American Bell Telephone Company against the National Telephone Manufacturing Company and the Century Telephone Company, which came up for final hearing a few days ago before Judge Brown in the United States Circuit Court. The issue related to the validity of the so-called Berliner patent. The case has been pending for several years. The actions are of an equitable nature, and seek relief from the alleged infringement by each of the defendants of the letters patent 463,569, dated Nov. 17, 1891, and issued to the complainant as assignee, Emile Berliner. It is contended by the defence that the Berliner patent is invalid, while the complaint maintains that the patent is valid and the defendants have infringed upon it.

CONNECTICUT STREET RAILWAYS.—The annual report of the figures given of the business of the 29 street railways in the state of Connecticut has just been completed by the railroad commissioners of the state and has been made public. The report shows a healthy condition in all the roads and a remarkably good showing of net earnings for the year. There are four street railroads in the state whose net earnings are over $100,000, six with net earnings over $50,000 and 11 over $25,000. Ten show gross earnings of over $100,000 for the year. Of the 29 street railroads 15 pay dividends, and of these seven paid over $25,000 out to the stockholders. The total capital stock of the street railroads in the state is $12,620,940; the bonds issued, $10,000,000; the floating indebtedness, $13,000,000; the cost of construction, $9,500,000; the equipment, $2,600,000; the gross earnings, $3,200,000; the net earnings, $1,200,000, and the dividends, $343,100. The taxes paid by the largest companies to the state aggregate $140,000. The total trackage of the state street railways is 496 miles, and of this 230 are owned by four companies, in Bridgeport, Hartford and New Haven. The largest company in the state is the Fair Haven & Westville, of New Haven, which owns a trackage of 84 miles, has a capital stock of $2,900,000, and net earnings for the year of $183,000 and dividends of $104,000. The next largest is the Hartford Street Railway, which has a trackage of 62 miles, net earnings of $180,900 and dividends of $42,000. The statement shows each of the companies to be in good condition, and many of them in the best possible.

PENNSYLVANIA AND OHIO NOTES.

Philadelphia, Nov. 13, 1899.

MR. FRANK H. STEWART, of Frank H. Stewart & Co., 35 North Seventh Street, Philadelphia, is enjoying a few days' hunting in the southern part of New Jersey, with some friends.

MR. J. P. BROWN has succeeded Mr. Charles D. Shain as New York representative of W. T. Pringle & Co., of 1026 Filbert Street, Philadelphia. Their New York office remains at the old address, 136 Liberty Street.

RAILWAY EXTENSION.—Additional engines and dynamos are being placed in the Camden & Suburban Railway's power station, as the extension of its lines and the adoption of heavier cars have made it necessary to increase the power. While these improvements are going on the company has made arrangements with the Camden, Gloucester & Woodbury Railway Company to supply the power necessary for the operation of some of the lines.

THE ELECTRIC STORAGE BATTERY COMPANY, Nineteenth Street and Allegheny Avenue, will erect a large addition to its reducing room, and has awarded a contract for the same to Charles McCaul. It will cost $7000. The same builder will erect for the same company an addition to be used as a machine shop and an engine house building, the latter being brick and iron, one-story high, with cement flooring, electric wiring, piping, drainage, slag roofing, etc.

THE CAMDEN & SUBURBAN RAILWAY COMPANY is going to extend its tracks to Riverton. Here they will meet the projected tracks of the Trenton & Camden Company, an extension of the old Monmouth Company, which will run between Trenton and Riverton. Articles of incorporation, changing the name of this company have been filed. In Camden the new company will connect with the Camden, Gloucester & Woodbury Railway, which will meet the projected line from Atlantic City. A few connecting links between lines already established will connect Trenton with New York's Jersey suburb.

THE RAILWAY COMPANIES GENERAL, of Philadelphia, is to form a continuous trunk trolley line from Lock Haven to Sunbury, a distance of 70 miles, in which route Williamsport is to become the chief city. Numerous branch lines are also to be constructed to places of importance near, but not on the main route. The Drexel syndicate of this city is said to be largely interested in the scheme. All the trolley lines between Lock Haven and Sunbury are to be acquired, while the company will construct the necessary track to connect them, so that a general trolley transportation business can be conducted between the end points named. The proposition also includes the building of a line from Lock Haven to Jersey Shore, the route of which has already been fixed upon. The electric plant at the latter place will be secured. The Lycoming Improvement Company is to be purchased, if possible, which would carry with it the control of all the electric and trolley interests, except the Edison Illuminating Company in Williamsport and South Williamsport. A branch line will be run to Hughesville and, after connection has been made beyond Muncy with the Milton, Lewisburg & Watsontown line, already controlled, the connection to Sunbury will be constructed.

Pittsburg, Pa., Nov. 11, 1899.

THE CHARTIERS LIGHT & POWER COMPANY, of Chartiers, Pa., has been purchased by Mellon Bros., the Pittsburg bankers.

MR. HENRY NOEL POTTER, electrician of the Westinghouse Company, who has been in Berlin for the last four years and whose home is now in Germany, is at present visiting friends in this city.

CAPT. J. DE LOTBINIERE, of the English Royal Engineers, at present acting agent of the Mysore state, India, passed through this city a few days ago on business. He stated that he had come to Pittsburg to confer with the Westinghouse Electric Company respecting the project of establishing an immense electric power plant, which is to be located in Mysore, on the Cauvery River, and the power will be utilized to electrically operate the many gold mines situated in that district.

Cincinnati, Ohio, Nov. 11, 1899.

MR. JACOBS, of the Triumph Company, is busy at the factory again after a business trip to Cleveland and Pittsburg.

MR. FRANK S. MARR, of the Helios Electric Company, of Philadelphia, has been calling on the local electric people during the week.

THE LAWTON-BEATTIE COMPANY will equip the Cincinnati Hospital with a complete electric outfit. There will be about 10 telephone stations, and more than average interest is taken in the matter.

THE H. WIGGERS & SONS' FURNITURE COMPANY will have a complete electric plant in connection with its factory and warerooms on Plum Street. The Lawton-Beattie Company has the contract.

PRESIDENT GEORGE BULLOCK, of the Bullock Electric Manufacturing Company, left for New York City to-day. Mr. Bullock while in the metropolis will arrange with Mr. R. T. Lozier, the New York representative of the company, to leave for England on Wednesday, Nov. 15, where the latter will attend to some important foreign business of the company. Mr. Lozier will be gone a month or more.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY received a fine cable order from London this morning for two big belted standard machines, 150-kw and three 50-hp motors for driving newspaper presses. This company will also furnish the Willson Aluminum Company, a prominent concern in Virginia, which will utilize a new water plant, three 800-kw generators. Business with the Bullocks is booming.

RAILWAY DEAL DROPPED TEMPORARILY.—The deal between Philadelphia capitalists and the stockholders of the Cincinnati, Covington & Newport Street Railway Company is temporarily off. The local people held out for 75 cents for their stock and the prospective purchasers were opposed to going higher than 60 or 65. The company, under the direction of President James C. Ernst, has been improving steadily for more than a year; prior to that the finances were at a low ebb.

Cleveland, Ohio, Nov. 11, 1899.

THE NORTH ELECTRIC COMPANY, Cleveland, is hard at work on the complete outfit for an independent telephone system for Chattanooga, Tenn. The contract aggregates over $100,000.

THE CLEVELAND & EASTERN RAILWAY COMPANY has decided to change the route for entering Cleveland and has applied to the county commissioners for a franchise over what is known as the Coventry road, making a shorter line into the city.

NEW RAILWAY COMPANY IN CLEVELAND.—Upon the application of a new company, known as the Citizens' Street Railway Company, the city council of Cleveland will advertise for bids for a franchise for a crosstown street railway, extending through the eastern portion of the city from the town of Glenville on the north, to Newburg on the south. The road would prove of great benefit to residents of the eastern section of the city.

THE CLEVELAND ELECTRIC COMPANY, Cleveland, reports that for a new and comparatively unknown apparatus its automatic time switch is making remarkable headway. It is receiving a large number of orders from all parts of the country, and has had a number of inquiries for samples from foreign countries. An order, which was a source of considerable gratification to the company, was that received a few days ago from the Chicago Edison Company for 50 switches, to be used in various portions of its plant.

THE CLEVELAND & CHAGRIN FALLS ELECTRIC RAILWAY COMPANY has secured the right of way for a new branch line from Chagrin Falls to Garrettsville, but, owing to the difficulty in securing material, the line may not be built this year. The recent report that this company was unable to carry out its plans on account of lack of capital, and that it had been granted an extension of time in order to complete its road was erroneous. These facts applied to an entirely different company. The Cleveland & Chagrin Falls Company has been in operation since May 1, 1897.

REPORTED DISSATISFACTION WITH RAILWAY ADMINISTRATION.—It is a matter of open discussion that many of the stockholders of the Cleveland Electric Railway are dissatisfied with the present administration of the road and it is stated that an effort will be made at the annual meeting in January to oust what is known as the Everett faction from the control of affairs. Considerable of the company's stock has changed hands within the past few days and prices have advanced several notches. This is generally believed to be an indication of a fight.

THE NUNGESSER ELECTRIC BATTERY COMPANY is receiving an enormous call for its No. 1 closed circuit battery from manufacturers of gasoline motor vehicles, the battery being especially adapted for sparking purposes. The output for the year will reach 1,000,000 cells, and the company is far behind on orders. Many of the orders are coming from abroad and the foreign demand is rapidly increasing. A few days ago a shipment of 5000 cells was made to an English motor vehicle concern and during the past week a shipment amounting to $2000 was made to a Western concern.

AUTOMOBILE RUNAWAY.—An electric vehicle ran away in Cleveland the other day and scattered pedestrians right and left. The trouble was caused by a crossing of wires in the motor connections. The operator and his companion alighted to remedy the trouble, but neglected to turn the controller handle to the "off" point. Naturally when the wires were straightened out the carriage started off. It was a speedy machine and tall sprinting on the part of the operator availed nothing until the carriage got off its course and sailed up against a big building. A damaged dash board was the only injury.

WESTERN NOTES.

Chicago, Ill., Nov. 11, 1899.

CHICAGO'S MUNICIPAL LIGHTS.—City Electrician Ellicott has submitted a report to Mayor Harrison showing the decrease in the cost of electric lights for the last four years. The figures allege there has been a decrease since 1895 from $8.30 to $4.48 in the average cost of each light per month. The figure $4.48 for this year is based on the figures of the first 10 months of the year.

FIRE.—On the afternoon of Nov. 4 fire partially destroyed the plant of the American Steel & Wire Company at Waukegan, Ill. The part affected by the fire was the finishing end, the rolling mill not being damaged in any respect. Arrangements have been made for the execution by the company's other plants of unfilled orders at Waukegan, so that there will be as little delay as possible in filling them.

TWO AND FOUR-CENT FARES.—Mr. C. L. Bonney, vice-president of the Chicago General Railway Company, has issued a statement which shows that the system of 2 and 4-cent fares has resulted in a 16 per cent. gain in gross receipts and 234.10 per cent. gain in the number of passengers carried. Two-cent tickets are sold on the stockyards, sanitary canal and power plant lines good for a ride of three miles. Four-cent tickets are issued on all lines, and the longest ride is six and a half miles.

WORK ON TELEPHONE TUNNEL STOPPED.—On complaint of Philo A. Otis and Bryan Bros., respective owners of the buildings at 158 and 160 La Salle Street, that the tunneling operations of the Illinois Telephone Construction Company were endangering the safety of buildings in the downtown district and already had made cracks in their structures, Commissioner of Public Works McGann has ordered a cessation of the company's work pending an investigation. The shaft was sunk to a depth of 25 feet. The tunnel is 4½ feet wide by 7 feet high. It is the intention to extend this tunneling throughout the district lying between Sixty-third Street on the south, Fullerton Avenue on the north and Western Avenue on the west, all the work to be carried on without tearing up or opening streets.

STREET RAILWAY CONSOLIDATION.—After repeated efforts to merge the three South Side suburban electric railroad companies into one consolidated company, the promoters are understood to have reached a working basis. The proposed consolidation has resolved itself into matters of detail. The new company will have a capital of not less than $10,000,000, and will buy outright the South Chicago City Railway, the Calumet Electric and the Chicago Electric Traction Company. There is also a report that the Chicago City Railway Company will lease to the new corporation all its present extensions south of Sixty-third Street, making the latter the dividing line for a double fare. The plan will closely follow that adopted by Charles T. Yerkes in merging all the outlying feeders for the North and West Side transportation into the Consolidated Electric.

WATER SUPPLY SHUT DOWN.—The water supplying the boilers in the Chicago City Railway power house, Forty-eighth Street and Oakley Avenue, was turned off one night last week and the engines were brought to a standstill. All the cars on the Wentworth Avenue, Halsted and Wallace Street lines were stopped from one to three hours. The Twenty-sixth, Thirty-first, Thirty-ninth, Forty-third, Forty-seventh, Fifty-ninth and Sixty-third Street crosstown lines also were tied up. The shutdown occurred at 6:30 o'clock when the rush of home-goers was on, and occasioned much inconvenience. Two-score of heavily loaded cars were brought to a standstill without any warning. After remaining in the cars for some time without any sign of relief the passengers were compelled to seek other means of transportation or walk. The reason for shutting off the water is in doubt. At 7:30 o'clock the water was turned on and the engines were started, and it was nearly 10 o'clock before the cars were running regularly.

Milwaukee, Wis., Nov. 11, 1899.

THE CHRISTIANSEN ENGINEERING COMPANY, manufacturers of air-brake apparatus for electric railways, is erecting a larger factory to meet the demands for its goods.

A. M. EINSTEIN and S. L. Clausen, of Chicago, have a petition before the common council of Janesville, Wis., for the granting of an electric railway franchise through the city, from Rockford, Ill., to Madison. Wis.

RAILWAY CONSTRUCTION RESUMED.—The work on the extension of the electric line from Sheboygan to Sheboygan Falls, which has been delayed for want of material, will now be pushed with renewed vigor, and in all probability the line will be completed by Dec. 1.

AUTOMOBILE COMPANY.—A $1,000,000 corporation for the manufacture of automobiles may be formed in this city. W. F. Davis, formerly vice-president of the Davis Gasoline Engine Company, of Waterloo, Iowa, is at the Charles Abresch Company's vehicle factory building the first machine.

JOHN JOHNSTON, who, with Carroll M. Town and Fred Johnson, is interested in the new Milwaukee & Muskegon Lake Electric Railway, which is to pass through Hales Corners, denies a report that the Milwaukee Electric Railway & Light Company is behind the new company. John I. Beggs also denies the report.

THE CUTLER-HAMMER MANUFACTURING COMPANY, which recently moved to this city from Chicago, has its new factory nearly fitted up. In a week or two the factory will be in full operation and will employ 150 or more men. This company is enjoying more business than can be handled. The officers of the company, Frank R. Bacon, president; F. L. Pierce, vice-president; H. H. Cutler, general manager; J. G. Hickcox, secretary and treasurer, and F. W. Smith, superintendent, and, with the exception of H. H. Cutler, are the same that formed the American Rheostat Company, formerly located here, but which moved to Chicago and consolidated with the Cutler-Hammer Company.

THE MILWAUKEE ELECTRIC COMPANY is experiencing a great rush of business. The fact that this company has been in business only five months and has orders booked to keep it busy day and night for six months to come is worthy of remark. It has some very large contracts in various parts of the country and is unable to meet the demand for its apparatus. The company has twice enlarged its facilities and again arrangements are under way for further improvements. It is shipping apparatus to London, England; South America, South Carolina, Virginia and various other places. This company deserves great credit for the advancement made and the manner in which its apparatus has met with such approval and demand.

Indianapolis, Ind., Nov. 11, 1899.

SEEKING A FRANCHISE.—The Independent Long Distance Telephone Company, of Indianapolis, has applied for a franchise at Seymour, with a view of connecting with Indianapolis.

PRIVATE ELECTRIC PLANT.—The largest private electric plant in Indiana has just been put in successful operation by the Ball Bros., fruit jar manufacturers, at Muncie. The factory is the largest of the kind in the world. The electric plant lights the entire factory and their four palatial residences. Three hundred incandescent and 50 arc lights are used, and many more will be required.

AN ADVERSE REPORT.—A special committee appointed by the council at Logansport to investigate the telephone situation, reported that the purchase of the independent plant was not feasible, and recommended the employment of an expert to approximate the cost of an entire new system, to be built and operated by the city. Since this report was adopted it is reported that the Bell Company has purchased the independent plant.

INDEPENDENT TELEPHONE COMPANIES CONSOLIDATE.—The Hartford City Telephone Company has come into possession of the Montpelier Telephone Company's plant, including the toll lines owned by the latter company. The plants will be consolidated and incorporated as one system. The home office and management will be at Hartford City. The Montpelier has 125 local patrons and connection with a number of stations in the oil field.

AFTER A CINCINNATI STREET RAILWAY.—Local capitalists are greatly interested in the developments in connection with the stock of the Cincinnati, Newport & Covington Street Railway. The prospective buyers (of a majority of the stock) are representatives of the American Railways Company, of which ex-President McLeod, of the Philadelphia & Reading Railroad, is the head. The company is desirous of acquiring all or a part—not less than a controlling interest—of the Cincinnati, Newport & Covington stock. The first proposition was $60 a share, but the large stockholders are holding out for $75. The Philadelphia parties are expected here to-day or to-morrow.

St. Louis, Mo., Nov. 10, 1899.

INDEPENDENT TELEPHONES IN NEVADA, MO.—A. S. Munsell & Co., of Atchinson, Kan., are building an independent telephone system from Nevada, to connect with Kansas City, Topeka, Kan., and Pittsburg, Kan. It will include a number of smaller towns. The Nevada local office is to have about 150 telephones, and it is to be fitted with the latest improvements.

THE UNITED RAILWAYS COMPANY is preparing to erect a large office building at Vandeventer and Park avenues. It will be three stories high and 84 by 127 feet and cost $40,000.

THE LINDELL RAILWAY WON.—The application of the Wabash Railroad Company for an order restraining the Lindell Railway Company from building cross-walks over its road bed, on the Bonhomme road, was refused by Judge Ferris, Nov. 6.

VENICE, ILL.—At a special meeting of the city council of Venice, Ill., last week an ordinance was passed granting E. G. Spencer, Fred E. Allen and D. R. Francis a franchise to construct an electric street railway from the Edwardsville Rock road to the southern limits of the city of Brooklyn. The road is to be constructed and equipped within six months from the acceptance of the franchise.

EXAMINATIONS OF MOTORMEN AND CONDUCTORS.—The St. Louis Transit Company has decided to adopt a physical standard for its employees and hereafter only those whose eyesight and hearing are good will be employed as motormen or conductors. A corps of physicians has already begun the examination of the employees as to their physical condition. The men were made to pass a strict examination as to their ability to distinguish different colors. The company has concluded that the safety of the public demands that the same standard of physical condition required by steam railways in its employees be adopted by the electric railway companies.

San Francisco, Cal., Nov. 4, 1899.

CITY DEPARTMENT OF ELECTRICITY.—The council of Los Angeles has passed the ordinance creating the department of electricity and providing regulations for wiring of buildings for electricity, etc.

THE OAKLAND (CAL.) AUTOMATIC TELEPHONE COMPANY recently filed articles of incorporation, with a capitalization of $500,000. The directors named are Albert C. Aitken, William A. Magee, Charles B. Taylor, Samuel S. Theller and E. C. Dozier.

THE SNOQUALMIE FALLS POWER COMPANY recently switched on its current to the city of Tacoma, Wash. The current is received at the Tacoma Railway & Power Company's power station, whence it is distributed through the city. The distance of transmission is 45 miles.

POWER HOUSE BURNED.—The Standard Electric Company, of California, recently lost its entire generating plant in Blue Lakes City, Cal., by fire. The fire broke out in the power house at an early hour in the morning, its origin being unknown. The building was not of very substantial construction, and the fine water power electric transmission apparatus was ruined. Stanley generators were in use. While the company will undoubtedly rebuild and carry out its plant for great extensions of its lines, the failure to obtain current has caused a number of mines and mills to shut down. The Stockton Gas & Electric Company will supply its patrons by means of its reserve steam plant. The Ford & Lightner mines on the Mother Lode have been compelled to close. The towns of San Andreas, Jackson and Sutter Creek were left in darkness. Angels Camp was also in the dark, but the Utica Mine Company's electric plant was about ready for operation and it can supply lights in and around Angels.

CANADIAN NOTES.

Ottawa, Ont., Nov. 11, 1899.

AMERICAN CORRESPONDENCE SCHOOLS IN CANADA.—An effort is being made by representatives of the American School of Correspondence, of Boston, Mass., to secure students in Ottawa. R. R. Miller and R. W. Geddes, of this school, are pushing its interests there. They are closely followed by L. B. Mann, of Boston, representing the International Correspondence Schools, of Scranton, Pa. As these two schools have put up a big fight in the United States, Mr. Mann is after the Boston men in Canada.

THE PACIFIC CABLE QUESTION.—The Australian agents general, who have been in attendance at the commercial congress recently held in Philadelphia, Pa., have arrived in Ottawa to consult with Sir Wilfrid Laurier on the Pacific cable question. The Australian delegates have every confidence in the ultimate success of the scheme. The following compose the delegation: Sir Andrew Clark, for Victoria; Hon. W. P. Reeves, for New Zealand; Hon. J. A. Cockburn, for South Australia. Sir Andrew Clark and Mr. Reeves are members of the Pacific cable board of control, on which body Canada is represented by the Earl of Aberdeen and Lord Strathcona. The members representing the imperial government have not yet been nominated.

THE SHAWINIGAN POWER COMPANY.—The Hon. Warner Miller, of New York, whose interests in the paper manufacturing business are very large, has been included in the directorate of the Shawinigan Water & Power Company, in the province of Quebec. The I. P. Morris Company, of Philadelphia, Pa., has been awarded the contract for two 6000-hp water wheels for use on the property. These wheels, which are to be completed by June 1, 1900, will be the largest and most powerful in existence, the next being those of the Niagara Falls Power Company. This contract will be followed by a contract for the electric generators, which also will be the largest and most powerful in the world. The company is making rapid progress in its works and the canal for the development of 50,000-hp is now nearly completed. The Pittsburg Reduction Company, which has contracted for the use of at least 10,000-hp, in the manufacture of aluminum, has just let to the R. D. Wood Company, of Philadelphia, the contract for the wheels, and to the Westinghouse Electric Company, of Pittsburg, the contract for the generators necessary for the development of 6000-hp. The Shawinigan Carbide Company, which has contracted for 10,000-hp, has completed all its plans, and is now laying out its site.

S. K. C. APPARATUS IN CANADA.—During the past four years the Royal Electric Company, of Montreal, sold in the Dominion S. K. C. generators having a total capacity of 50,000-kw. The Royal Electric Company secured the exclusive right to manufacture S. K. C. apparatus in Canada, and its factory is thoroughly equipped with modern tools and appliances.

General News.

THE TELEGRAPH AND TELEPHONE.

GREENVILLE, W. VA.—The Greenville Telephone Company has been incorporated, with a capital of $10,000.

CLARKSVILLE, TENN.—The Clarksville Telephone & Telegraph Company has been organized, with a capital of $1000.

LOGANSPORT, IND., proposes to go in at once for a municipal telephone system owned by the city, like the electric light plant.

LEXINGTON, KY.—The Messrs. Shely, of this place, have just finished a new telephone exchange at Frankfort, putting in 364 telephones.

PARIS, TEXAS.—An extension of the Deport and Detroit telephone line has just been completed to Rosalie and Bogata, in Red River County.

DES MOINES, IOWA.—The Johnson County Telephone Company has been organized in Iowa City. Capital, $25,000. Incorporators: A. T. Presson, H. L. North, D. Maher, all of Iowa City.

FORT SCOTT, KAN.—The stockholders of the Union Long Distance Telephone Company, an independent company with 180 miles in southeastern Kansas, have decided to extend the line at once from Ottawa north to Kansas City by way of Leavenworth.

ALBANY, N. Y.—The People's Telephone Company, of Ontario County, has been incorporated with a capital of $8000. Incorporators: G. B. Hemingway, G. R. Granby, of Naples; M. A. Case, of Bristol Centre; R. E. Jones, of Holcomb; E. C. Church, of Canandaigua; J. E. Lyon, of Naples.

MEADVILLE, PA.—The construction of the lines of the new Meadville Telephone Company is progressing rapidly. The lines in the business section of the city are placed entirely in the alleys, thus avoiding any further congestion of poles. This arrangement is adopted wherever feasible in other parts of the city.

JACKSBORO, TEXAS.—The Southwestern Telegraph & Telephone Company has just completed a line of telephone from Bridgeport to Jacksboro, with a copper wire, this giving Jacksboro first-class service. The connection of the new line does away with the old line that has been in use between here and Weatherford for many years.

BELOIT, WIS.—Circuit Judge B. F. Dunwiddie has rendered a decision that the Wisconsin Telephone Company cannot erect poles and string wires in highways without the consent of property owners. The corporation attempted to do this in Beloit last spring, but was restrained by an injunction issued in behalf of William B. Strong, who owns large property interests here. The case will be appealed.

BALTIMORE, MD.—The United Telephone & Telegraph Company has been organized by Baltimore men, with a capital of $5,000,000. The new company is to absorb the Maryland Telephone & Telegraph Company, of Baltimore, and the Pittsburg & Allegheny Telephone Company, of Pittsburg. This is to be followed by the securing of control of a number of other independent exchanges in various cities and connecting the different cities by a long distance service.

TRENTON, N. J.—Articles of incorporation have been filed here for the United Telephone & Telegraph Company, with an authorized capital of $5,000,000. The company is organized to construct telephone and telegraph lines, to manufacture appliances for the same and to furnish heat, light and power. The incorporators are Alexander Brown, Henry A. Parr, Thomas J. Haywood, L. Davies Warfield and James Bond, all of Baltimore, and John Headdon, Jersey City.

ERIE TELEPHONE.—The Erie Telephone Company's large growth is reflected in its North Texas division, which has increased its subscribers in 12 months 100 per cent. It is not generally known outside of the company's territory, but the Pacific Coast Company's rates adopted six months ago by the Erie Telephone system furnishes apparatus in such cities as Cleveland, Detroit, Milwaukee, Minneapolis, St. Paul, in fact throughout the whole system as low as five cents per day. This permits one outward communication, no charge being made for inward calls.

ATLANTA, GA.—The long distance lines of the American Telephone & Telegraph Company connecting the north and south were formally opened on Nov. 1. President McKinley, from his office in the White House, in conversation with Colonel Robert J. Lowry, president of the Lowry Banking Company, congratulated the City of Atlanta and the south upon having completed this new commercial link which binds the country closer together. During the evening communication was had with New York, Baltimore, Washington, Chicago and other points.

BINGHAMTON, N. Y.—The New York & Pennsylvania Telegraph & Telephone Company, on Nov. 10, gave a mortgage of $1,000,000 on its lines to the Washington Trust Company, of New York. The mortgage is to cover bonds issued by the telephone company to the amount of $300,000. The money is to be used in extending the company's lines through this state and Pennsylvania and strengthen the present system, with a view, it is stated, to combat the new telephone combine recently organized. In order to provide for further extension and paying the bonds the company has authorized the issue of $1,000,000 worth of 4 per cent. interest-bearing bonds, payable Nov. 1, 1919.

ELECTRIC LIGHT AND POWER.

NUNDA, N. Y.—The Citizens' Electric Light & Manufacturing Company has increased its capital from $10,000 to $15,000.

AUBURN, ILL.—The Auburn Electric Light Company has been incorporated with a capital stock of $8000. Incorporators: J. A. Wheeler, W. H. Ramsey, George W. Hatton.

COLUMBUS, OHIO.—The Ceramic City Light Company, of East Liverpool, has been incorporated with a capital of $200,000. Incorporators: L. W. Healy, J. H. Brooks, F. H. Croxall, G. O. Anderson, H. H. Blythe.

SEDALIA, MO.—The board of directors of the Sedalia Water & Light Company has confirmed the contracts recently made for new additions to the plant in the way of boilers, condensers and electric light machinery.

ALBANY, N. Y.—The Fort Edward Electric Light & Power Company (limited) has sold its plant to the United Gas, Electric Light & Fuel Company, of Sandy Hill and Fort Edward. The new company has a capital stock of $150,000.

CALUMET, MICH.—Calumet capitalists are organizing a stock company to erect an electric lighting plant at the little townsite of Lake View, a mile from the city, and purpose to furnish lights for business houses and residences in Calumet, Red Jacket and Laurium. They intend to run an underground system of wiring from the plant to the city.

JOHNSON CITY, TENN.—The Watauga Lighting & Power Company, of Johnson City, has undertaken to dam the Watauga River in Washington County, Tenn. The power is to be used for electrical purposes, and it is said that the company contemplates in this connection extending the Johnson City street railway to points in the surrounding country.

ALBANY, N. Y.—The Clinton Electric Company, of Clinton, to furnish gas and electricity, has been incorporated with a capital stock of $50,000. Twelve other cities and towns in Oneida County will also be supplied by the company with light, heat and power. The directors are John N. Williamson, of Bone Park; Thomas W. Cantwell, Albany; Thos. F. McBride and James L. Dempsey, of Clinton.

MOUNT HOLLY, N. J.—Eighteen acres of land here, including valuable water rights, have been transferred to the American Investment Company by Mrs. Richard C. Shreve. The company will replace the present mill dam with a substantial stone dam capable of impounding a big head of water. Sufficient power will be obtained to operate a big electrical power house, which is to be located beside the dam. The power generated here will be used for all purposes here and transmitted to Haddonfield, Merchantville and Moorestown, where the company now has plants, and will also be available for other points as soon as contracts for lighting and power can be obtained.

THE ELECTRIC RAILWAY.

DOVER, DEL.—The British Electric Street Tramways Company has been incorporated under the Delaware laws, with a capital of $5,000,000. The incorporators are W. L. Sawyer and E. Martin, of New York, and James Virdin, of Dover, Del.

RAILWAY MATERIAL WANTED.—The Kanawha Traction & Electric Company, Kanawha, W. Va., will soon be in the market for a full line of railway supplies. Reference to this company's plans was made in these columns Oct. 28.

DOVER, DEL.—The London Electric Tramways Construction & Maintenance Company has been incorporated in Delaware, with a capital of $2,500,000. The incorporators are W. L. Sawyer and E. Martin, of New York, and James Virdin, of Dover, Del.

HARRISBURG, PA.—The Wilkesbarre Street Railway Company has been incorporated to construct and operate a street railway. Capital, $60,000. The incorporators are M. B. Williams, W. Conyngham, J. N. Conyngham, A. A. Sterling, all of Wilkesbarre; A. G. Nesbitt, of Kingston.

HARRISBURG, PA.—The electric railway between Lewistown and Reedsville, in which Philadelphia and Harrisburg capitalists are interested, is about completed and ready for operation. The power house and car barn are finished and also much of the tracks. Cars will be running before the first of the year.

JERSEY CITY, N. J.—A mortgage for $20,000,000 on the franchise and entire plant of the Jersey City, Hoboken and Paterson Railway Company in Hudson, Passaic and Bergen Counties has been filed here. The mortgage is given to the New Jersey Title Guarantee & Trust Company, of Jersey City, to secure an issue of $20,000,000 in bonds.

MONTCLAIR, N. J.—The Montclair town council passed the amended ordinance granting to the North Jersey Street Railway Company a franchise for a street railway to the south end of the town through Elm Street and Orange road to the Orange line. The ordinance provides for a ten-cent fare to Orange from Montclair when a direct route is made.

MEADVILLE, PA.—A project is well under way for the sale of the property of the People's Incandescent Electric Light, Heat & Power Company to the Meadville Traction Company. The Traction Company, with their great surplus of power, are in a position to operate the electric light system much more cheaply than the present concern, and by combining the two interests can readily make a material saving in their joint operation.

READING, PA.—It is now almost assured that the Reading and Temple Electric Railway, between this city and Temple, five miles, will be built next spring. Agents of the United Traction Company purchased several tracts of land, and the right of way has now been secured with the exception of a short distance. The Allentown & Kutztown Railway Company is making arrangement to extend its line to Temple. This will form a continuous line between Reading and Allentown, taking in all the principal towns.

CLEVELAND, OHIO.—Eugene Rawdon, of Windsor, Ohio, has obtained franchises for 250 miles of electric railway to complete an electric railway system from this city to Pittsburg with branches to Titusville, Penn., and Edinborough, Penn., where it will connect with the Rapid Transit Company. The franchises are for 50 and 99 years. It is estimated that $4,000,000 will be required to put the project through. Mr. Rawdon says the forming of the new company will be taken in hand by Philadelphia capitalists, to whom he will turn over the franchises.

WINSTON, N. C.—The Twin City Construction Company, which has heretofore owned the Winston-Salem Railway & Electric Company, has sold its plant to the Fries Manufacturing & Power Company and several northern gentlemen, who will in the future operate it. The transaction involved nearly a million dollars. The new management will extend the line south of Salem and make improvements on the entire plant. The officers of the Fries Manufacturing & Power Company are: H. E. Fries, president; H. W. Fries and W. A. Blain, vice-presidents, and B. J. Pfohl, secretary and treasurer, all of Winston-Salem.

THE FORT WAYNE TRACTION COMPANY.—The directors of the Fort Wayne Traction Company, of Fort Wayne, Ind., which has recently passed into the hands of Cleveland capitalists, held their meeting last Wednesday and elected officers as follows: J. H. Wade, president; E. H. Bourne, vice-president; H. E. Gresham, secretary, and H. T. Eells, treasurer. The directors are J. H. Wade, E. H. Bourne, E. T. Eells, Gen. G. A. Garretson, J. M. Parmelee and H. P. McIntosh, all of Cleveland, and John H. Bass, of Fort Wayne. The change in management will probably result in the removal of one or two of the Cleveland gentlemen to that city.

BIDDEFORD, ME.—Petitions have been filed for the incorporation of two companies to build electric roads to run into Biddeford. One is to be known as the York County Electric Railroad Company and proposes to construct a line from Biddeford, through Goodwins Mill and Waterboro and Limerick to Holtonville, a woolen manufacturing village in Limerick. This line will be 25 miles in length. The route crosses the Portland & Rochester Railway at Center Waterboro. The capitalization is $250,000. The other proposed road is to be known as the Biddeford, Kennebunk and Wells line and is to connect those places. The capital stock is $200,000.

ANDERSON, IND.—Contracts for the largest electrical plant west of Niagara were let on Nov. 6 by the Union Traction Company of Indiana. It will cost $1,000,000. Power will be generated at this plant for the 108 miles of interurban electric road now in operation or under construction in Anderson, Muncie, Marion, Elwood, Alexandria, Orestes, Summitville, Fairmount, Gas City, Jonesborough, Pendleton, Middletown, and other points. Electric power will also be furnished to housekeepers and manufacturers in all the cities touched by the company. The company claims that it will be able to light cities more cheaply than the cities can operate their own plants.

PITTSBURG, PA.—The Consolidated Traction Company, of Pittsburg, is negotiating for a lease of the United Traction Company. The United Traction Company is controlled through ownership of stock by the Philadelphia Company which, in turn, is controlled by a syndicate headed by the Messrs. Alexander Brown & Sons, of Baltimore, and Brown Bros. & Company, of Philadelphia and New York. Alexander Brown, of Baltimore, is conducting the negotiations on the part of the Philadelphia Company and State Senator C. L. Magee, of Pittsburg, on the part of the Consolidated Traction Company. It is generally believed there will be a consolidation of all the street railway properties of Pittsburg by the end of the present year, but it is uncertain whether it will be upon the basis of the lease of the United Traction by the Consolidated Traction or the absorption of the latter by the Philadelphia Company. The Philadelphia Company is a consolidation of all the natural and manufactured gas and electric light plants and the United Traction Companies, of Pittsburg. It is capitalized at $21,000,000, of which $6,000,000 is 5 per cent. noncumulative preferred stock.

THE AUTOMOBILE.

AUTOMOBILE TO TOW BOATS.—At Hartford (Conn.) work has been begun on an automobile which is intended to tow canal boats on the Erie Canal. The automobile, it is stated, will be built on entirely new plans and is intended to be powerful enough to tow from six to 10 canal boats at once. It will cost more than $4000.

AUTOMOBILES IN PUERTO RICO.—James O. Hughart and Edward W. Fitzgerald, of Grand Rapids, Mich., and C. R. Marquardt, of Mt. Clemens, Mich., and the chief promoters of a company which will operate a line of automobiles in competition with a railroad in Puerto Rico. The line will run over the government road from Ponce to San Juan and will carry both freight and passengers.

PERSONAL.

PROF. HUGO DIEMER has been appointed professor of mechanical engineering at Agricultural and Mechanical College, Greensboro, N. C.

MR. ROBERT T. LOZIER, manager of the New York office of the Bullock Electric Manufacturing Company, sailed on the steamship Oceanic on Wednesday, Nov. 15, for an extensive trip through Europe. While, of course, there may be some business thrust upon Mr. Lozier while there, the object of the trip is entirely pleasure-seeking.

FARRAND-CHAMPENOIS.—The marriage occurred on Nov. 9, at Lincoln Park, Newark, N. J., of Mr. Dudley Farrand, the well-known general manager of the People's Electric Light & Power Company, of Newark, to Miss Jane, younger daughter of Mr. and Mrs. Isaac Champenois. A host of well wishers extend their congratulations to the happy pair, who are now away on their honeymoon.

MR. W. J. JOHNSTON IN JAPAN.—Mr. W. J. Johnston sailed Nov. 2 for Korea, and after spending about ten days in that country will proceed to Tien-Tsin and thence to Shanghai, Hong Kong, Manila, etc. Before leaving Japan a dinner was given in his honor in Tokyo, by Mr. S. Katogi, editor of *The Electrical Friend*, and Prof. I. Fujioka, president of the Tokyo Electric Company. During a stay of some weeks in Japan, Mr. Johnston visited the chief places of interest there, spending a considerable portion of the time in Tokyo, Kobe and Kyoto, at all of which places there is at present a very considerable electrical development.

PROF. HENRY A. ROWLAND, director of the physical department at Johns Hopkins University, has recently received two unusually high honors in addition to his already long list of distinctions. As already noted, at the organization of the American Physical Society, held at Columbia University, New York, he was elected to be its first president. Upon his return from New York he was formally notified of his election as foreign member for America of the Royal Society of Lombardy, the National Scientific Society of Italy, which corresponds to the better-known Royal Society of London, Royal Society of Edinburgh, and the French Academy, of all of which he is already a member.

EDUCATIONAL.

MR. CALVIN W. RICE, electrician for the New York Consolidated Telegraph & Electrical Subway Company and the New York Gas & Electric Light, Heat & Power Company, is to visit Purdue University and lecture on Nov. 15 before the students of electrical engineering on "The Development of High Tension Service." While in Lafayette Mr. Rice will be entertained by Prof. W. E. Goldsborough.

LEGAL.

CORPORATION TAXES.—The supreme court of Iowa has pronounced unconstitutional and void the state law providing for levying a tax on the gross earnings of insurance, express, telegraph, telephone and sleeping car companies, and fast freight lines in lieu of all other taxes. The court holds that corporations must be assessed on the same basis and for the same purpose as individuals. "A corporation paying its entire taxes to the state," says the court, "does not help support city, county and schools, as individuals must do, hence the law is unconstitutional."

SPRAGUE SUSPENSION PATENT.—On Nov. 10, in the United States circuit court for the eastern district of New York, Judge Thomas rendered an opinion respecting the Sprague motor suspension patent that has heretofore figured in litigation against the Walker Company, prior to its consolidation with the Westinghouse Company. Judge Thomas construed claims 2 and 6 of the motor suspension patent No. 324,892 differently from the construction heretofore given to that patent, and held those claims to be good and valid and infringed. The title of this case is Sprague Electric Railway & Motor Company vs. Nassau Electric Railroad Company, and it was defended by the Lorain Steel Company.

COOK VS. WESTERN ELECTRIC.—Owing to the serious illness of Mr. C. C. Bulkley, attorney for the complainant, the final hearing in the Court of Appeals at Washington of the suit of Frank B. Cook against the Western Electric Company for infringement of patent on telephone and switchboard protectors, has been postponed from the November to the January term. We are informed that Mr. Cook, who is now president of the Sterling Electric Company, will turn his attention to some of the other presumptive violators of his patent rights as soon as the decision in the above case has been rendered, and which he believes there is every reason to expect will be in his favor, his claims having already been upheld three times in the lower courts.

Trade and Industrial Notes.

BULLOCK APPARATUS.—That there is confidence in Bullock apparatus is made clear to the Central Electric Company, Chicago, by reason of several large orders lately closed.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that the Gutmann recording wattmeter is taking well in the trade. It is quite jubilant over the demand for the instrument.

THE MILWAUKEE OFFICE of the Martin J. Insull Company, the western selling agents of the General Incandescent Arc Light Company, has been moved from Pabst Building to 408 Uihlein Building.

WIRE LAMP GUARDS.—The Western Electric Company, Chicago, has just issued a bulletin on the New "Century" No. 10 incandescent lamp guard, the "Improved Perfection" No. 1 lamp guard and the "Perfection" No. 2 lamp guard. All are illustrated. A price list is also given.

THE LEA MANUFACTURING COMPANY, Elwood, Ind., has moved into its new factory which is fully equipped with automatic machinery for producing duplicate lamp parts. Altogether the company is in a much better position to meet the increasing demand for its enclosed arc lamps of both the direct and alternating current types.

INTERIOR CONDUIT CATALOGUE.—The Sprague Electric Company, New York, has just issued a very handsome catalogue (No. 75) on interior conduit—iron armored, brass armored, unarmored and flexible metallic—and insulating fittings. The catalogue contains 148 pages and is profusely illustrated. Price lists are also given.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY, Cleveland, has recently added the manufacture of complete telephones to its business. The company claims several new and valuable features, among them a long arm transmitter with concealed cord. A circular has just been published, fully describing the new telephone.

MR. O. C. ROEDDER, of 739 West Lexington Street, Baltimore, has been appointed the representative in this country for the galvanic battery used in the Krieger automobile recently referred to in this journal as one of the features of the Motor Carriage Exposition at Berlin. The battery is covered by United States patent No. 603,890, relating to a regenerable negative electrode.

THE DIAMOND STATE STEEL COMPANY has awarded all the contracts for its new steel plant, at Wilmington. Among the contracts are the following: Electric generator, Westinghouse Company, of Pittsburg; engines,

Fischer Manufacturing Company, of Pittsburg, and William Todd & Co., of Youngstown, Ohio; electric cranes, Morgan Engine Company, of Alliance, Ohio; electric charging machines, Wellman-Seaver Engine Company, of Cleveland, Ohio.

THE A. A. McCREARY COMPANY, 136 Liberty Street, New York, has issued catalogue No. 1 of McCreary's electrical specialties. These include reflectors for incandescent lamps, half shades, paper shades, flexible brackets, portables, desk lamps, etc. The catalogue is illustrated with cuts of these various articles, and the prices of the same are also given. This company on Sept. 1 last took over the entire business of Mr. A. A. McCreary in "McCreary Electrical Specialties."

THE AMERICAN SCHOOL OF CORRESPONDENCE, of Boston, Mass., offers an electrical engineering course, which is carefully supervised by electrical experts, in close touch with the developments in the science. The instruction is graded and thoroughly practical and scientific, and is intended to give to electrical students and engineers a complete training. The students' work is carefully inspected by well known electrical experts.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued two trade bulletins—No. 3004 and No. 3006. The former relates to the automatic illumination cylinder or revolving automatic switch for electric signs, illuminations and decorations, and the latter to alternating current, single phase, power motors. The company is making forge blowers with alternating current motors. It is claimed that a workman can do at least one-fourth more work with the aid of one of these blowers.

THE FALCON ELECTRIC MANUFACTURING COMPANY, 432 East Seventy-first Street, New York, has issued its Bulletin No. 1, in which is catalogued "Falcon" all-drawn pure copper knife switches. These switches are mounted on black enameled slate bases. They are made in the single and double throw, single break types, with single, double and triple poles, and are manufactured in strict accordance with the rules of the National Board of Underwriters. Connection blocks and fuse blocks on slate bases are also listed. This company makes special switches, switchboards and panel boards.

ADJUSTABLE SHADE LAMP AND COVERETTE.—The Pacific Electric Company, La Crosse, Wis., is pushing the Espersen adjustable shade lamp, which is made in a great variety of styles. This device is said to afford complete protection to the eyes of those who are compelled to use electric light at the desk. This company is also meeting with success with its Pacific coverette. This article is a flexible covering for incandescent cord, telephone wires and electric wires. It is cheap, durable and attractive—three important considerations. The Pacific coverette has been favorably passed upon by the board of electrical inspectors in Chicago.

GOOD WORK OF A DRY BATTERY.—A report, very gratifying to the Non-Polarizing Dry Battery Company, 625 Broadway, New York, comes from the Thompson & Norris Company, Brooklyn, N. Y. This concern reports that on Nov. 6, 1897, it placed two of these batteries in an electric clock. They have been in regular service ever since without any sign of weakness or deterioration. In that time—over two years now—the clock has never stopped. The Thompson & Norris Company say that the battery has given service that they never thought could be realized from any battery, wet or dry. They are highly pleased with their O. K. dry batteries.

QUEEN & CO. present in a new circular the latest forms of standard apparatus for the production of X-ray. The portable forms deserve particular attention both on account of their "take down" peculiarities and their light weight. A new form of Radiographic table is illustrated showing several methods of use. The Queen self-regulating X-ray tube is fully described and its special advantages are given in detail. A new form of tube for use on an alternating current is illustrated. This has the same vacuum regulating device as the direct current tube and is free from the undesirable feature common to many double focus tubes, of having two points from which the X-rays emanate. Parties interested in this line of work would do well to write for this pamphlet.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that its telephone department is crowded with orders. It has recently closed a deal with the Victor Telephone Manufacturing Company, whereby it virtually agrees to handle the entire output of this large factory, having taken the exclusive agency for this company in the south and west of the Mississippi River—a territory covering 27 states. This apparatus embodies everything new and good in telephone and switchboard construction. The company is putting upon the market a switchboard which embodies all the good points of the old switchboard, and many new and novel ones. Anyone contemplating installing a telephone exchange and line, or who is interested in telephones will find it to their advantage to examine this apparatus.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED NOV. 7, 1899.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,783. ELECTRIC MOTOR; T. Duncan, Chicago, Ill. App. filed Oct. 12, 1899. (See Current News and Notes.)

11,786. ELECTROMAGNETIC BRAKE; F. C. Newell, Chicago, Ill. App. filed June 15, 1899. (See Current News and Notes.)

636,241. METHOD OF AND MEANS FOR CONTROLLING SYSTEMS OF DISTRIBUTION; C. A. Brown, Chicago, Ill. App, filed March 22, 1897. (See Current News and Notes.)

636,244. PORTABLE IGNITER PLANT; A. W. Crosby, Geneseo, Kan. App. filed May 20, 1899. This is a device for lighting cigars and comprehends an acetylene gas generator and a flexible tube leading therefrom to a burner on a handle, the burner being equipped with electric sparking terminals which throw a spark simultaneously with the outflow of gas.

636,270. VACUUM ARC LAMP; J. H. Loos, Orange, N. J. App. filed Dec. 15, 1898. In this lamp a magnet is used to strike the arc only, the lower carbon being fed upward by hand by means of a screw plug passing through the bottom of the lamp.

636,275. SIGNAL FOR TELEPHONE TRUNK LINES; F. R. McBerty, Downers Grove, Ill. App. filed Sept. 25, 1896. The object is to lessen the number of switch contacts on a switchboard which is connected with another board, or boards, by trunk lines. The invention may be described generally as consisting in the combination, with the trunk line, its spring-jack, and the signaling circuit, including signals at the distant terminal of the trunk line and connected with the spring-jack, of a pair of plugs and their plug circuit for making connection between the trunk line jack, and another spring-jack, a conductor connected with the plug, adapted to form an extension of the signaling circuit and an appliance in association or connection with the plug circuit, which is moved or whose relations are changed simultaneously with or in the act of removing the connection with the call-initiating line for changing the connections of the signaling circuit to operate the signals.

636,276. SIGNAL FOR TELEPHONE TRUNK LINES; F. R. McBerty. Downers Grove, Ill. App. filed Sept. 25, 1896. Related to the preceding.

636,277. APPARATUS FOR INTEROFFICE TRUNK LINES; F. R. McBERTY, Downers Grove, Ill. App. filed Sept. 25, 1896. Related to the preceding.

636,286. AUTOMATIC ELECTRIC SWITCH; E. F. Porter, Boston, Mass. App. filed Dec. 27, 1897. This switch is operated by a thermostat, the latter consisting of two arms moved by variations of heat to close one or other of two circuits, one circuit controlling the make and the other the break of a main circuit.

636,299. TROLLEY; E. G. Solomon, Omaha, Neb. App. filed July 24, 1899. The device is so constructed that should the trolley slip from the trolley wire it would be encountered by one of two wheels which are mounted adjacent to the trolley proper, and riding upon these wheels would be slowly directed into the trolley.

636,313. MEANS FOR CONTROLLING RAILWAY TRAINS; H. Biermann, Breslau, Germany. App. filed March 9, 1897. Two sets of clockwork are located at a station. One of them is so controlled by the train electrically that a definite number of revolutions of an axle advances the hand of the clockwork to a succeeding division on the dial. One clockwork checks off the time and the other the distance covered. The clockworks are so arranged that when they are not in unison an alarm is sent in, which is proof that the train is not maintaining a prescribed speed.

636,318. BATTERY; C. E. Burroughs, New York, N. Y. App. filed Nov. 21, 1898. (See Current News and Notes.)

636,336. INCANDESCENT LAMP HOLDER OR RECEPTACLE; G. A. Harter, Chicago, Ill. App. filed March 4, 1899. Lamp sockets of simple construction are mounted in a tray which is afterward filled with an insulating plastic compound to hold the sockets all in position. The tray may then be used as a part of an electric sign.

636,358. ELECTRIC ARC LAMP; R. Schefbauer, Jersey City, N. J. App. filed Aug. 6, 1898. These improvements relate to the clutch which is applied to a drum over which a carbon carrying chain passes. The clutch consists of three arms arranged to be thrown into gripping contact with the interior wall of the drum by the feeding magnet, and out of contact by a separate device.

636,360. ELECTRIC SWITCH; F. Schmedtmann, St. Louis, Mo. App. filed March 15, 1899. This is a knife switch, in which the blade is locked in its closed position, the lock being released by the handle in its movement to open the switch.

636,366. TELEPHONE SYSTEM; E. P. Trayer and D. E. A. Reynolds, New York. App. filed Dec. 6, 1897. The object of this invention is stated to be "cheap service for people of little means," the invention consisting in the details of construction of the switching apparatus.

636,399. ELECTRIC CUT-OUT. J. Erikson, Providence, R. I. App. filed Feb. 11, 1899. The fuse wire is enclosed in a transparent tube and surrounded by a material that will become visibly changed by the fusing of the wire, thus showing which fuse has been destroyed.

636,429. ELECTRIC LIGHTING APPARATUS FOR VEHICLES; G. Heidle, St. Louis, Mo. App. filed Feb. 13, 1899. A casing contains a small dynamo which connects electrically with a lamp on the outside of the casing. The armature shaft extends through the casing and carries a friction wheel which receives motion by contact with the rim of one of the wheels of the vehicle.

636,441. LIGHTNING ARRESTER; W. Messick, Timberville, Va. App. filed Aug. 8, 1899. Details of construction.

636,458. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed Jan. 23, 1899. The contacts are of laminated metal and are held closed by a lever which is detained by an electromagnet in the circuit.

636,475. INSULATING JOINT; C. Wagner, New York. App. filed Oct. 12, 1898. The essential feature of the invention is the use of two shells of cylindrical form, one being placed within the other and suitably insulated, thereby producing a joint which will not disfigure the fixture or wall to which it is attached.

636,486. ELECTRIC CIRCUIT CLOSER; J. J. Busenbenz, Chicago, Ill. App. filed March 13, 1899. This is a contact device particularly for electric clocks, and consists of a rotary cylinder containing mercury, and an arm, which is caused to sweep through the mercury at intervals to close the circuit.

636,519. TRANSMISSION OF SOUND; E. Gray, Highland Park, Ill., and A. J. Mundy, Newton, Mass. App. filed April 14, 1899. (See Current News and Notes.)

636,520. TRANSMISSION OF SOUND AND DEVICE FOR CARRYING SAME INTO EFFECT; E. Gray, Highland Park, Ill. App. filed June 23, 1899. (See Current News and Notes.)

636,529. MOTOR CARRIAGE; E. Henriquez, Brussels, Belgium. App. filed Jan. 18, 1899. (See Current News and Notes.)

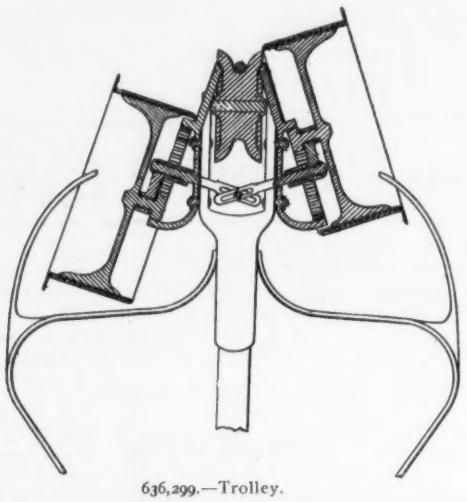
636,565. SAFETY FUSE; J. Sachs, New York, N. Y. App. filed Nov. 14, 1898. (See Current News and Notes.)

636,577. ELECTRIC APPARATUS; H. W. Smith and W. J. Baughman, Pittsfield, Mass. App. filed April 10, 1899. The object is to prevent the flashing which occurs when an electric circuit is opened and consists of a pair of terminals located in an arcing space provided with an escape passage and a spreading and chilling device adjacent to the escape passage to interrupt the arc.

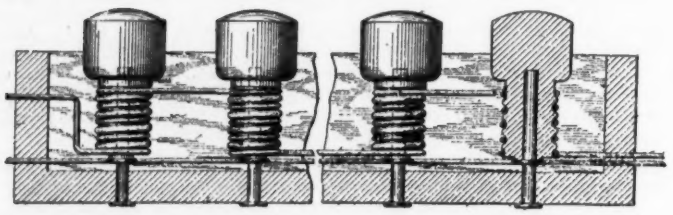
636,578. THERMAL CUT-OUT; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 7, 1899. (See Current News and Notes.)

636,604. AUTOMATIC RAILWAY SIGNAL; J. M. Williams and T. P. & H. W. Kinney, Lynchburg, Va. App. filed June 14, 1899. The signal mechanism comprises a gong box, distant track boxes electrically connected with the gong box, near track boxes adapted to be electrically connected with the gong box after a train has passed a given point, means for ringing the gong and means for sending the same again after the train has passed.

636,621. CARBON CLUTCH BRACKET; P. Bleidt, Little Rock, Ark. App. filed Aug. 25, 1899. The invention includes a bracket having an end turned at an angle, a follower arranged to slide in the bracket and having a lateral extension, and a screw mounted in the extension and passing through the turned end of the bracket for raising and lowering the follower. One end of the clutch lever indicates that the follower and thus by manipulation of the follower a clutch jaw carried by the lever is moved toward and away from the carbon carrier.



636,299.—Trolley.



636,336.—Incandescent Lamp Holder or Receptacle.

636,638. MEANS FOR INTERCEPTING EARTH CURRENTS IN ELECTRICAL TRACTION; W. Cramer, Hagen, Germany. App. filed Aug. 19, 1899. (See Currents News and Notes.)

636,676. SANITARY ATTACHMENT FOR TELPHONE TRANSMITTERS; W. Lenderoth, New York, N. Y. App. filed March 9, 1899. (See Current News and Notes.)

636,685. WEIGHT OR PRESSURE RECORDING APPARATUS; E. McGarvey, Bellefont, Pa. App. filed Jan. 12, 1899. By this invention weight, pressures and the like may be accurately recorded at any point near to or distant from the weighing scale or indicating instrument, the apparatus including as well as the electric transmitting devices an instantaneous weighing scale.

636,721. ADVERTISING APPARATUS; W. H. Gilman, Boston, Mass. App filed Aug. 28, 1897. An advertising apparatus comprising a translucent pane or sheet having a picture or design, said picture presenting an opaque appearance when illuminated wholly from the front, and being obscurable or effaceable by an excess of light from the back, and means for admitting light to portions of the back of the pane, whereby the corresponding portions of the picture are obscured or effaced, the other portions of the picture remaining visible and forming a framing or setting for the portions of the pane on which the picture is thus obscured or effaced, said last mentioned portions being illuminated and caused by the translucence of the pane or sheet to stand out in strong contrast with the surrounding portions of the picture so that relatively small areas having the form of letters may be flashed conspicuously upon any desired part or parts of the picture.

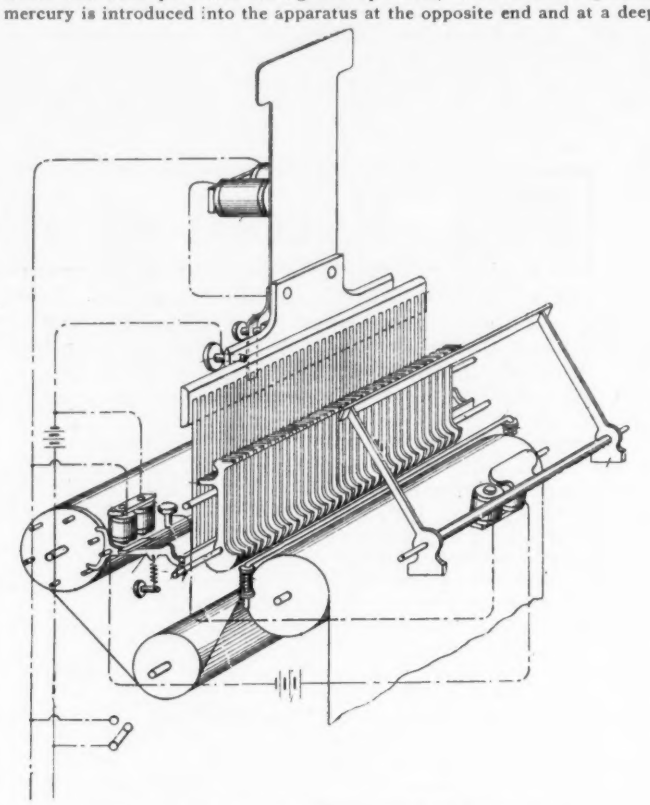
GERMAN PATENTS, ISSUED OCT. 25, 1899.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

104,297. CURRENT CONTROLLER FOR STORAGE BATTERY CIRCUITS; American Railway Electric Light Company, New York. App. filed Nov. 30, 1897. This device produces a current of constant strength, even if the speed of the dynamo feeding the circuit should vary. An electromagnet in series with the lamps and a suitable current interrupter and both in shunt with the main circuit, act on a two-armed lever, the opposite end of which is connected to a spiral spring, which latter operates a solenoid in the main circuit. If the current in the lamp circuits becomes interrupted, the tension of the spiral spring will be diminished and the strength of the current in the main circuit will be brought down to a predetermined figure.

104,649. CONTROLLER FOR ALTERNATING ARC LAMPS; Frank Lervis and the Mutual Electric Trust, Limited, London. App. filed Jan. 11, 1898. In order to regulate the length of the arc, transformers are provided having movable coils or a variable magnetic shunt circuit. The variation of the current intensity in the shunt circuit produces a motion of the coils or the iron parts, and this motion regulates the distance of the carbon points.

104,900. APPARATUS FOR CONTINUOUS ELECTROLYSIS OF ALKALIES; Solvay & Co., Brussels, Belgium. App. filed March 19, 1898. The apparatus is provided with a dividing wall over which the amalgam runs which has been produced during the operation, whereas the regenerated mercury is introduced into the apparatus at the opposite end and at a deeper place. The object of this arrangement is to impart motion to the amalgam only at its surface, and the same may be accelerated by having the electrolyte run in the same direction as the amalgam.



636,085.—Weight and Pressure Recording Apparatus.

105,007. ELECTROLYTIC PRODUCTION OF COMPOUNDS BY MEANS OF THE ALTERNATING CURRENT; Charles W. Roepper and Joseph William Richards, Bethlehem, Pa. App. filed April 27, 1899. The process consists in employing an electrolyte, one component of which acting electrolytically and alternately upon the electrodes, forms a compound with the material of the electrodes, which is insoluble in the electrolyte, as well as in the products resulting from the action of the current on the second electrode. One process, for instance, consists in the production of an insoluble compound on one electrode and of a gas on the other electrode. The production of cadmium sulphate, for instance, may be accomplished by employing cadmium electrodes and an electrolyte of a 10 per cent. solution of sodiumthiosulphate. The alternating current will produce on each electrode insoluble cadmiumsulphate during its employment as anode, and hydrogen during its employment as cathode.

105,008. ELECTROLYTIC PRODUCTION OF ALKALI-PERSULPHATE AND ALKALI-PERMANGANATE; Frank Deipler, Berlin. App. filed Aug. 14, 1898. The object of this process is to avoid the reducing action of hydrogen by keeping the cathode solution entirely free from all products of oxidation. This is accomplished by surrounding the anode with a solution of high specific gravity and the cathode with one of low specific gravity, and sustaining these conditions during the electrolytic oxidation. In addition, there may be employed a horizontal diaphragm, made of a very porous substance, which offers to the electric current but a small resistance.

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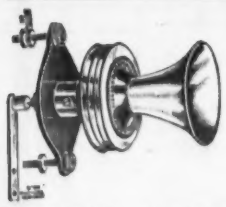

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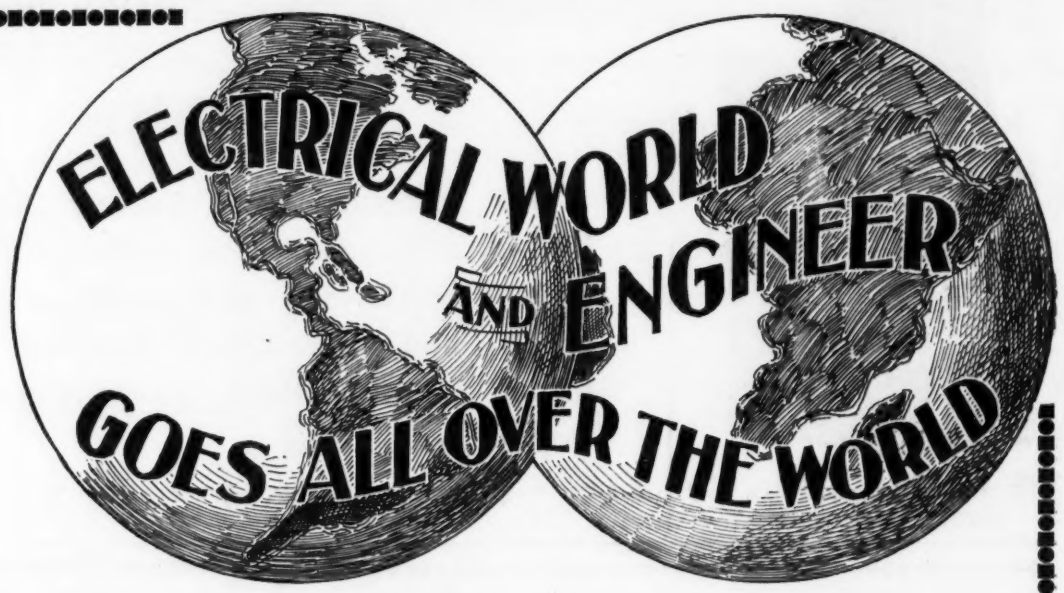

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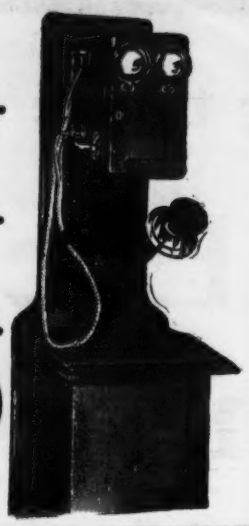

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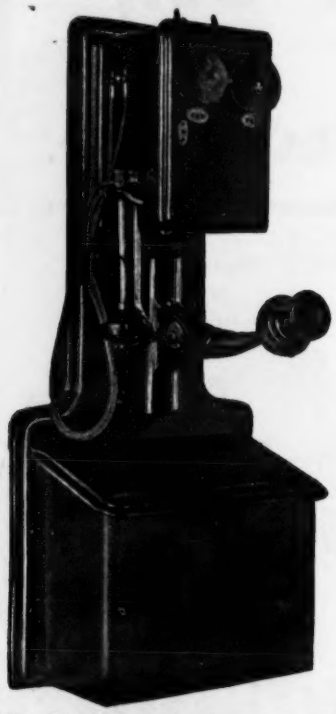

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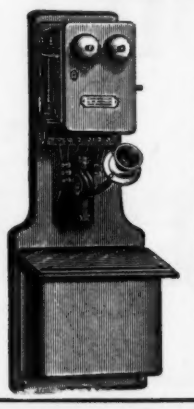

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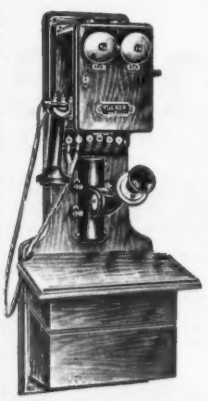

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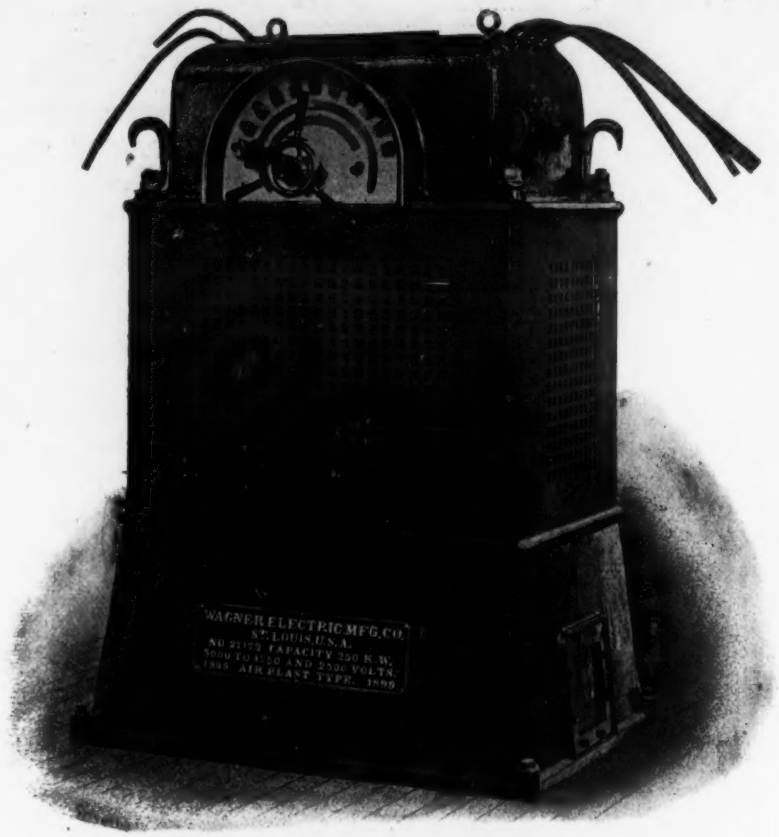

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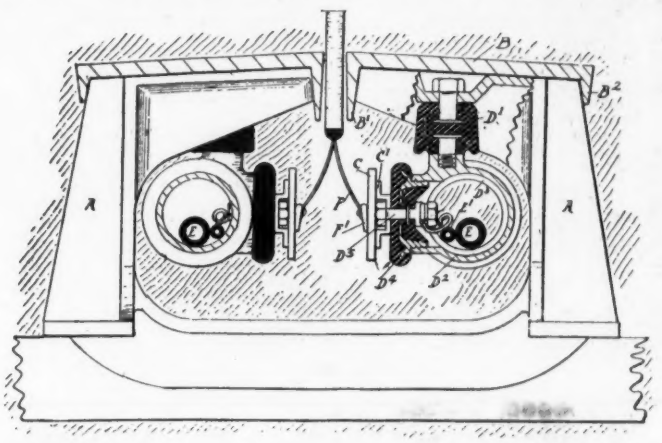

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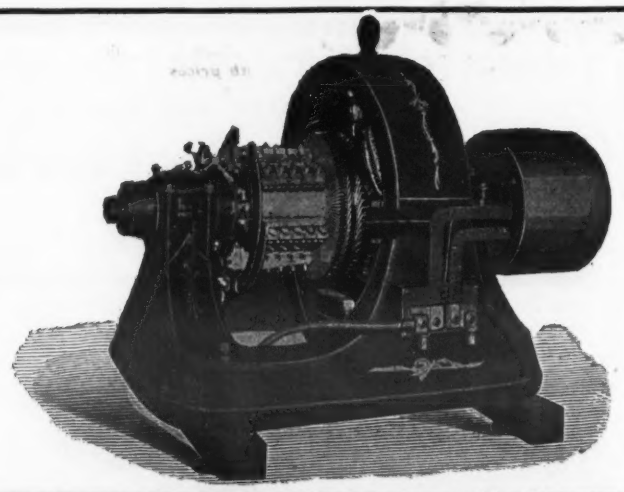

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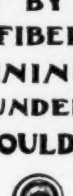

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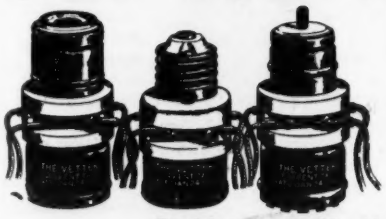

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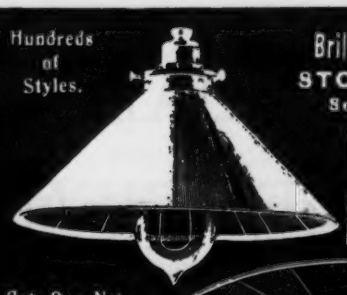
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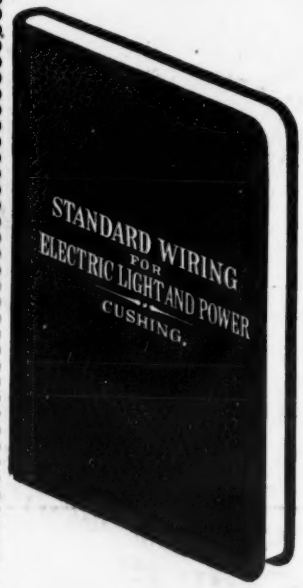

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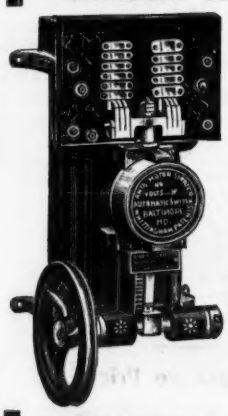
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